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ABSTRACT

Using an econometric model of four simultaneous equations for State cross-sectional data and of two equations for city cross-sections, the following determinants were estimated: (1) current spending on education, (2) the ratio of vocational to current educational expenditures, (3) the over-all enrollment rate in public schools, and (4) the percentage of publicly enrolled students in vocational programs. Interrelationships among these variables are significant. Particularly, current spending per student and over-all enrollments interact so that attempts to increase instructional resources available to each pupil are frustrated by changes in enrollments. In addition to feedbacks among these endogenous variables, influences of 26 exogenous variables, including proxies for racial, religious, occupational, and industry mixes were examined. These are notable determinants of spending per student or enrollment rates, as are other variables representing factors that help to establish demand for educational services. Important variables in this latter category are income levels, income distribution, adult educational attainments, and competing claims on public resources. An appreciable impact of State and Federal educational aid is also present. Finally, instructional costs affect educational spending per pupil, but putative effects of higher salaries are diluted possibly by scale economies to districts, factor substitutions, or changes in teacher-student ratios. (Author)

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Final Report

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A SIMULTANEOUS EQUATIONS ECONOMETRIC MODEL OF THE DETERMINANTS OF VOCATIONAL AND NON-VOCATIONAL SPENDING AND ENROLLMENT

March, 1972

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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Abstract

Using an econometric model, of four simultaneous equations for state cross-sectional data and of two equations for city cross-sections, we estimated the determinants of (1) current spending on education, (2) the ratio of vocational to current educational expenditures, (3) the over-all enrollment rate in public schools, and (4) the percentage of publicly enrolled students in vocational programs. Interrelationships among these variables are significant. Particularly, current spending per student and over-all enrollments interact so that attempts to increase instructional resources available to each pupil are frustrated by changes in enrollments. In addition to feedbacks among these endogenous variables, we examined influences of twenty-six exogenous variables, including proxies for racial, religious, occupational, and industry mixes. These are notable determinants of spending per student or enrollment rates, as are other variables representing factors that a priori help to establish demand for educational services. Important variables in this latter category are income levels, income distribution, adult educational attainments, and competing claims on public resources. An appreciable impact of state and federal educational aid is also present. Finally, instructional costs affect educational spending per pupil, but putative effects of higher salaries are diluted possibly by scale economies to districts, factor substitutions, or changes in teacher-student ratios.

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Part 1 -- Introduction

Since so many characteristics of contemporary American society are without true historical analogs it is little wonder that our educational system has, compared to those of other modern societies, been insulated from centralized planning activities. Rather, American education is virtually unique in its evolutionary, pragmatic, pluralistic development. Still, while centralized planning mechanisms have played a relatively minimal role, planning of a different, more immediate, sort has been inescapable. Try as he might, man has yet to devise a social institution in which decisions can be totally avoided. To the degree that man has been partially successful in these attempts he has tended also to maximize the importance of those necessary decisions that remain. This seems to be an ineluctable organizational development in social institutions. The educational system -- one of our most vital social institutions -- has been no exception. Educational planning, in the United States especially at the state and local levels of government, is an inevitable adjunct of effective decision making. To the extend that decision making has been institutionalized within the educational system planning takes on a more vital role.

Yet the basic contention undergirding this research effort is that educational planning has tended to overlook effects of two unparalleled traits of the American people. Or rather, the results of a quantitative interaction of these two characteristics have evaded the attention of educational planners. Not that educators have consciously wanted to ignore the consequences of this interaction. It is just that quantitative evidence on the results of this interaction -- evidence that can easily be incorporated in the planning process -- has not been available.

The interaction we allude to stems from two undeniable facets of contemporary American life. First, Americans, by any conceivable measure, are a highly mobile community. Second, observation of past results has created in the United States a vast majority that is convinced of the existence of a strongly positive relationship between personal economic and social benefits and the level of personal formal educational attainments. In a sense crucial to educational planning, this second characteristic gives an added dimension to the first. The very high standard of living most Americans enjoy has made a high degree of geographical mobility realizable. This standard of living, which, among other things, permits universal education, combined with the American conception of the economic and social roles of education have made upward social mobility a feasible goal for most individuals. The result is that the United States, like no other mature country, is in a highly excited state of geographical and social flux. The American educational system occupies a pivotal position in this process and, of course, a large part of its evolution can be explained as an adaptation to this set of circumstances.

Recognition of this feature of American education is far from profound. To aver that educators have all but ignored the consequences of rapid and massive social and geographical movement would do them a disservice.[1] It has long been suspicioned that as educational spending per student has increased -- and this is typically used as a rough proxy for improvement in the quality of education -- enrollments have also expanded. Thus, enrollment adjustments have tended to offset seeming improvements in educational quality. These adjustments have been facilitated both by geographical mobility of the American people and by the assumed role of the educational system in generating economic and social gains. Moreover, given the absence of an absolute fixity of tax resources to be employed by schools, the response to the resultant relative reduction in educational spending per pupil has been the levying of further tax revenues, and their funnelling into educational channels, in order to "bring up to par" and even increase educational outlays per student. Thus, in the educational system there has been a recognized interrelationship between per student spending and enrollment response that has been partially self-defeating: in a circular process, educational spending increases have generated enrollment reactions and then tax responses that have presumably resulted in lesser improvements in the quality of education -- as measured by per pupil outlays -- than seem defensible to the public in terms of the expanding tax allocations to the educational system.

Given the preponderance of the school tax bite at the local government level, this phenomenon is no doubt part of the explanation of the so-called "tax payers' revolt" of recent years.[2] Knowledge of the quantitative nature of the spending-enrollment interrelationship would place educators in a better position to explain the process. More rational educational planning would be possible, as would more intelligent tax decisions on the part of voters.

Strictly within the framework of educational planning, however, there is an additional complexity arising from the interaction of per pupil expenditures and enrollments. One of the ticklish budgeting problems facing an educator is the allocation of a given amount of funds available to the educational system among various types of programs.[3] There are, of course, many programmatic claims upon educational resources. One of the more important of these -- for which statistical information is collected -- is the allocation of educational resources into vocational programs. Not only does vocational education fill a particular need in our society; it is also, relatively speaking, the beneficiary of large amounts of federal support.

Here again, in educational budgetary decisions the interrelationship between outlays per student and enrollments has operational significance. Local funds directed into vocational programs are unavailable to meet other educational needs. Assuming, not unrealistically, that the educational planner operates under a fixed over-all budget constraint, an increase in vocational education outlays per student may not only draw "new" students into the vocational programs of, say, a particular school district; it may also result in a shuffling of students between vocational and non-vocational programs within a given school district. These enrollment reactions may result in relatively lower per pupil outlays in vocational programs, although the budgetary decision was presumably based upon a felt need to "beef up" vocational education. Conversely, due to the enrollment responses, there may be in non-vocational education programs an unintended increase in expenditures per student as a result of the decision to augment the vocational programs. Similarly, a decision on the part of educators to allocate a larger portion of a given amount of funds into non-vocational education programs may, because of enrollment reactions and contrary to intentions, result in higher per pupil outlays in vocational programs and reduced per student spending in non-vocational education. In short, the interaction between programmatic spending decisions and enrollment responses may make it extremely difficult for the educational planner to appear to achieve the results he intends.

This, of course, is an unenviable position. At best, the well-intentioned educational planner may seem incompetent; at worst, disingenuous. With the widespread acceptance of spending per student as a measure of educational quality, even a diligent effort to implement improvements in, say, vocational education, may, because of the spending-enrollment interaction, be under-cut. Indeed, the interrelationship between increases in spending per student on specific educational programs and enrollment responses to these spending changes may make it impossible to "show" an improvement in that particular program's educational quality. In this situation, the rational budgetary decision would have been seemingly counter-productive!

This would be an extreme case, of course; but given present knowledge the possibility cannot be ruled out completely. The more typical situation is probably one in which a budgetary decision to expand outlays in a particular educational program may result in lower gains in per pupil expenditures than was anticipated. The point is, however, that despite realization that this problem of educational planning exists, we simply do not now know the quantitative nature of the interrelationship between per student outlays on these broad educational categories -- vocational and non-vocational programs -- and per student enrollments in these programs. Removing this informational gap is the primary goal of the present econometric research effort.

In pursuing this goal we have been constrained, as in any econometric study, by the types of data available and by the conditions implicit in the statistical techniques we have employed. The nature of these two constraints will be discussed more fully in the body of this report. Suffice it here to indicate that the spending and enrollment variables we have concentrated on are not those mentioned above. It seemed appropriate to examine only <u>current</u> educational spending per student, and hence to leave out of account those outlays which are for capital purposes and for meeting interest payments on contractual indebtedness. This omission was consistent with our initial presumption that the hypothesized spending-enrollment interaction was a short-run phenomenon which needed to be considered for short-term planning purposes and that the very difficult accounting problems of allocating capital facilities over various educational programs would lead to disquieting error size in the spending variables. For statistical reasons it made no sense to break down spending into its vocational and non-vocational categories. Rather, we have explained current spending on vocational programs as a ratio of total spending, on the one hand, and per pupil current spending on all educational programs on the other.

There is, then, in our study no expenditure category called non-vocational spending, even though the above description has contained this term in order to highlight the nature of the educational planning problem on which we hope to shed light. Finally, because we wished to avoid the much more grandiose problem of having to "explain" populations of cities and states in order to examine the spending-enrollment interrelationship, and also because we wished to minimize collinearity among the several independent variables, we have expressed the enrollment variables in terms of enrollment per capita. That is, an enrollment rate rather than numbers of students enrolled, again contrary to the implication of the discussion just above, was employed to give expression to the enrollment aspect of the presumed spending-enrollment interaction. The reason underlying this decision will become apparent as we outline the nature of the econometric model that we have developed in order to quantify the presumed spending-enrollment interrelationship.

Since we are positing the existence of a simultaneous interrelationship between two spending variables, i.e., current outlays per student on education and a spending ratio for vocational programs, on the one hand, and two corresponding enrollment rate variables, on the other, we thought it best to employ the so-called two-stage least squares statistical technique in estimating the coefficients of the several variables in the various equations. The two-stage least squares (2SLS) estimating procedure yields statistically consistent estimates of the parameters of the structural equations when mutual interactions are a salient feature of the conceptual model.[4] However, to our knowledge no estimates of a spending-enrollment relationship using a statistically consistent estimating technique have yet been published. Since we wished to have a basis for comparison with the results of previous studies, and also because we wished to obtain internally an estimate of the effects of not using a consistent estimating procedure, we have computed estimates of the structural coefficients using the ordinary least squares (OLS) technique. A priori, we expect that differences between coefficient estimates for the endogenous variables from 2SLS and OLS procedures will reflect the signs of these coefficients. We found this indeed to be the case, as is explained later in greater detail.

We have specified the spending-enrollment interaction model in an equational form that is linear in the logarithms of the several variables. We have two reasons for using this log-linear format. (1) In a pilot study, similar in character to the present effort, in which cross-sectional educational spending and enrollment data from urban areas were used, it was found that a log-linear specification of the model provided a better statistical fit than did an arithmetically linear format for the equations.[5] Partly, the better performance of log-linear equations is due to the fact that this form, at least compared to an arithmetically linear one, is superior at picking up the influence of independent variables that are subject to relatively wide variations. Since several wide-ranging variables appear in the present study we thought it advisable, without actually undertaking arithmetically linear estimates for comparative purposes, to employ a log-linear format. (2) As will become apparent when we describe in detail the theoretical underpinnings of the present econometric model, the use of a log-linear equation format facilitates the conversion of the *a priori* model from a per capita basis to a per student basis. The latter basis is much preferable for purposes of discussing the potential consequences for educational planning of the quantitative results we expect to find.

It should be noted, furthermore, and this is an advantage of the log-linear format, that the use of this equational form compels a particular interpretation of the coefficients of the variables in the several regressions. The effects of changes in the explanatory variables must be couched in percentage terms, rather than in terms of arithmetically incremental changes. In the parlance of economics, the coefficients of the several variables express "partial elasticities," or net percentage adjustments in the dependent variable which correspond to a percentage change of one unit in the given independent variable assuming that the other independent variables are unchanging. Because of the nature of the computational process, however, the numerical value of this adjustment in the dependent variable is assumed to be that which would occur if the unit percentage change in the independent variable took place when the latter variable was at its arithmetic mean value for the sample used in deriving the statistical estimates, and when all other independent variables are "held" at their respective means. Thus, the coefficients in the regressions are described as "percentage changes about the means." The regression coefficients really give no valid clue to any relationship between the dependent variable and the independent variables when the sizes of the latter differ significantly from their mean values, although they are frequently used for this purpose. This restriction on interpretation of the regression results should be borne in mind throughout the discussion.

The backbone of this study consists of five separate sets of regression estimates of a simultaneous equations model designed to highlight the spending-enrollment interaction between general education programs and vocational programs. In other words, we have used a particular econometric model to exploit five different sets of data. In every case, these data are "cross-sectional" in character. Each time datum selected for these cross-sections -- 1962, 1957, and 1952 -- was, of course, forced upon us by the availability of published statistical information over the cross-sections we wished to utilize. The cross-sections themselves were, on the one hand, the forty-eight contiguous states (Alaska, Hawaii, and the District of Columbia were excluded from the sample because a complete set of data for the several independent variables could not be marshalled for them.) and, on the other hand, the seventy-nine largest urban core areas as defined by the Bureau of the Census in its development of data for Standard Metropolitan Statistical Areas. An enumeration of these urban areas is given in Appendix A. Because of data gaps, we were unable to build up a complete set of information for the cities for 1952. Consequently, the econometric model was estimated from state-by-state data for 1962, 1957, and 1952 -- three sets of regression estimates -- and from city-by-city data for 1962 and 1957 -- two sets of estimates.

These five sets of regression results will be analyzed subsequently; and, of course, attention will be given to salient differences in the results adduced from these separate regressions. Moreover, it is possible to depict the basic econometric model in terms of changes in the several variables from one time period to another, still however using cross-sectional data. We call our estimates derived from using in the regression runs this form of the cross-sectional data, i.e., taking period-to-period differences in the variables, rather than levels of the variables, the "dynamic version" of the basic model. We have econometric results for this dynamic model as well. They too will be discussed in a later section of this report. But before we can intelligently examine and analyze the results of our regression estimates we must explain, in reasonable detail, the nature of our basic econometric model of the interaction between spending on education and on vocational educational programs and enrollment rates in public education generally and in vocational programs.

Part 2 -- Empirical Specification of the Basic Model

We have determined to adapt an econometric model in order to analyze the determinants of enrollment rates in vocational and non-vocational public education programs and of spending on these types of programs. Previous studies, relying largely on the theoretical work of Becker,[6] have examined this quantitative relationship, but only in a limited and unsatisfactory fashion.[7] These have been inadequate empirical studies primarily because they have been estimated, in isolation, either the determinants of educational spending or the determinants of enrollment. These researchers have exploited single-equation econometric models, giving no recognition to the potentially significant mutual interactions between spending and enrollment. Moreover, they have not examined their models for the possibility of interrelationships, within an over-all budgetary constraint, between spending on different types of educational programs and enrollments in these different programs.

It is these two deficiencies, in particular, that we hope to eliminate by estimating a four-equation simultaneous econometric model in which spending on education, on vocational programs and educational enrollment rates and those in vocational programs are endogenously determined variables. This has not been attempted heretofore.[8] In the following pages, we will examine seriatim the potential determining factors of each of these endogenous variables. In this discussion we will also provide our *a priori* expectations about the signs of the parameters of the several explanatory variables. Conventionally, sources of data are also cited along with the particular specification of the variable. We have decided against this tradition in order to leave the description of the basic model uncluttered. Rather, the sources of our data are listed in Appendix B.

The Determinants of Current Educational Spending Per Student -- Educational expenditures per student are in principle based on community preference patterns as expressed through a particular political power configuration, but importantly subject to institutional conditions in which educational services are produced and also subject to the constraints of educational budgets.[9] In order to stress current educational planning and decisions, we have chosen as our spending variable current expenditures per enrolled student by all local government units in a given state or a given urban area. By selecting current educational outlays we can avoid estimating problems caused by the extreme annual irregularity of outlays on capital facilities. Moreover, current expenditures omit interest payments which are of little moment for current decision-making, since interest outlays are set largely by past interest rates and methods of financing previously constructed facilities. Finally, since we are concerned with the basic choice of type of schooling, rather than with the number of students using a facility at a particular time, we use total enrollments rather than average daily attendance as our numeraire. Thus, to repeat, the dependent variable in the first of our simultaneous equations is current educational spending per enrolled student.

It has been shown previously that the student's desire for schooling and the community's demand for education are both influenced by family income and parental educational attainments.[10] Consequently, significant independent variables in the spending equation should be per capita income and the educational level of the population, as evidenced, for example, by median education. Both of these demand-influencing variables are to be found in the estimated spending equation.

Morgan, et al.,[11] also observed that, for a given number of children in low-income and nonwhite families, public education is most beneficial to those groups that have greatest difficulty paying for it. "The tendency for benefits of free education to be concentrated among families with greatest need persists even when white and nonwhite [families] are considered separately. [But] nonwhite families benefit disproportionately, both absolutely and relative to their income levels, from the provision of free public education." Recognizing that the benefits and the burdens of public education are not coincident family by family, we have included in our regression analysis the percent of families with income below three thousand dollars and the percent of population that is nonwhite.[12] This allows for the view that the distribution of income and the racial mix of a community influence the willingness of the tax paying unit to spend on public schools. Moreover, in situations where strong racial prejudice exists and where nonwhites exercise limited power over public spending decisions, the statistical effects of the racial mix variable will be augmented.

The proportion of the populace attending public schools should also positively affect willingness to spend on public education. Enrollment rate differences for any area may be attributable to: (1) age structure variations, and (2) parental choice between private and public education for their children. An area with a relatively large school age population is likely to be in favor of larger education outlays because of a greater number of parental beneficiaries. An additional factor, reinforcing this, is that such areas are apt to have a proportionately smaller dependent old age population[13] with its competing demands upon the resources of the public sector. Also, the positive effect of a large school age population on educational spending may be augmented over time if the development of local pride in public education makes sustained large education budgets more politically acceptable.

Where a large proportion of families in an area has elected to send its children to public schools we are apt to find substantial support for public education. Putting children in private schools will probably have little observable effect on a family's state-enforced taxation to support public schools, whereas it adds substantially to that family's overall outlays on education. In the aggregate, of course, a switch of children from public to private education would reduce the cost of a given quality of public schooling to the community generally. Nevertheless, families with no children of school age and those with children in private schools are probably less eager to underwrite public school education of even constant quality, preferring rather to minimize their school tax burdens. These factors suggest, then, a positive influence of the public school enrollment rate on public educational spending per student.[14] This relationship is one of the important components of the simultaneous interaction that we expect to find.

We must consider also the impact of the general public budget constraint, a ceiling which is set according to the public's opinion about the appropriate size of government budgets and tolerable tax impositions, given the level of income in an area. School budget differences, responding to variations in the proportion of the population in public schools, are apt to be less than proportional. This would mean that per pupil educational outlays would be negatively associated with the enrollment rate, and hence tend to counteract the effect discussed in the preceding paragraph. Accordingly, the _a priori_ direction of the _net_ enrollment effect on educational spending is uncertain; one influence may offset the other. In short, we have no judgment beforehand of the expected "direction" of the simultaneous impact.

Our model must reflect the fact that there are alternative demands on the public sector for a share of the limited public resources, especially since educational expenditures bulk so large. Other things being equal, these competing demands will oblige local governments to devote fewer resources to education than would a locality faced virtually solely with educational needs. To accommodate this phenomenon, we incorporate as explanatory variables population size and population density as proxy expressions for alternative budgetary demands. Other studies have shown these to be useful proxies for competing uses of budgetary funds.[15]

The cost of educational inputs and the characteristics of the production function which relates factor requirements to a chosen level of output of educational services also help determine educational spending. Specifically, we expect that there may be economies or diseconomies of scale to increased scope for educational inputs, even though generally speaking an identical set of educational technologies is available to all school systems. In order to allow for scale effects, we have included in our spending equation a variable for the mean enrollment per operating school district in the cross-sectional area.[16] It is possible, however, especially for the urban areas, that the districts in our sample are appreciably larger than those for which scale economies have been found. This possibility, plus the possibility that district size might serve as a proxy for educational environment and student background,[17] make it difficult to attach an a priori expectation to the sign of the coefficient of this variable.

Several variables are candidates for measuring the effects of the cost of educational inputs on spending per student. The most crucial of these is probably teachers' salaries, represented in our study by the mean value. Of course, this variable as a measure of educational costs is not completely free of defects. The net influence of variations in teachers' salaries on spending per pupil may be partially offset by a related, economizing adjustment in number of teachers employed. That is, student-teacher ratios may be positively associated with teachers' salaries. Moreover, average teachers' salaries may themselves be affected by the quality of education, via a larger demand for teachers in better quality schools or by a greater willingness of teachers to work in such schools. If this is so, salaries should be treated endogenously in our model. A consistent simultaneous treatment of teacher's salaries is, however, not undertaken in this study.

Another variable viewed as having a potential influence on per pupil outlays is the proportion of total enrollment in public high schools, since presumably secondary school students have an appreciably larger need than elementary school students for relatively costly specialized personnel and equipment. Beyond this, vocational education is more expensive. We measure its impact via the proportion of students who are enrolled in vocational education programs, bringing in, in this way, another of the anticipated simultaneously determined relationships. Of course, if other educational spending is cut to permit added outlays on vocational programs, then no systematic relationship will be apparent.

The degree of constraint imposed by the public budget depends not only on private aggregate incomes in the area, but also on the extent of non-resident taxation and on the availability of funds from other governmental levels. These factors have opened the door to the inclusion of several fiscal variables in our model. For example, the willingness of voters to raise funds for the public sector is inevitably influenced by the extent to which the structure of taxes enables the fiscal burden to be shifted to outsiders or to those with less political weight. To reflect this consideration several "tax capacity" variables are found in the model.

Any model of educational spending would be incomplete without consideration of the property tax. Hence, we have incorporated per capita assessed taxable property corrected to equivalent true market value.[18] We also include the proportion of this property tax base that is not commercial or industrial, on the premise that taxes on this base are not so easily "passed on" so that local tax payers are more directly affected by the fiscal pinch. This, then, gives us an (inverse) indication of the influence of non-resident taxation on per pupil educational spending.

Moreover, local governments, which are most directly responsible for administering educational spending, tend to view state and federal aid as net increments to revenues, thus somewhat relaxing the local budget constraint and facilitating increased educational spending. The manner of local response to expanded aid -- whether it is basically stimulative or substitutive and whether allocation decisions are warped -- is still being debated.[19] Even so, it is beyond question that even if allocation formulas for outside aid affect some spending decisions by reducing the local cost component, as well as by entailing legal obligations, the overall fungibility of local tax funds permits limited readjustments so that local governments can spend pretty much as they wish. To embrace this range of fiscal effects we include separately total state and total direct federal aid per capita in our spending equation.[20]

The final specification of the estimating equation for total current spending per student is given in equation (1).

(1) $Y_1 = A + a_1Y_2 + a_2Y_5 + a_3X_1 + a_4X_2 + a_5X_3 + a_6X_4$
$+ a_7X_5 + a_8X_6 + a_9X_7 + a_{10}X_8 + a_{11}X_9 + a_{12}X_{10}$
$+ a_{13}X_{11} + a_{14}X_{12} + a_{15}X_{13} + e_1.$

This equation will be estimated in its log-linear form for reasons already mentioned and discussed further below. In this equation:

Y_1 = log of current spending on education per publicly enrolled student;

Y_2 = log of publicly enrolled students per capita;

Y_5 = log of enrolled students in vocational programs as a proportion of all publicly enrolled students;

X_1 = log of money income per capita;

X_2 = log of percent of families with income less than \$3,000;

X_3 = log of median years of school completed by the population over 25 years of age;

X_4 = log of percent of population that is nonwhite;

X_5 = log of population per square mile;

X_6 = log of population;

X_7 = log of average teachers' salary;

X_8 = log of percent of publicly enrolled students in high school;

X_9 = log of publicly enrolled students per operating school district;

X_{10} = log of market value of taxable property per capita;

X_{11} = log of percent of taxable property which is not commercial or industrial;

X_{12} = log of intergovernmental revenues received from the state government per capita;

X_{13} = log of intergovernmental revenues received from the federal government per capita; and

e_1 = random error term.

Given our previous discussion, we would expect *a priori* the above regression coefficients to take on the following signs: a_3, a_5, a_9, a_{10}, a_{12}, a_{14}, and a_{15} would be positive; a_4, a_6, a_7, a_8, and a_{13} would be negative; and a_1, a_2, and a_{11} would be uncertain.

The Determinants of Vocational Spending as a Proportion of Total Current Spending -- For reasons already outlined a convenient specification for the vocational spending variable is the ratio of vocational to total current educational outlays. Given this specification of the variable, along with the log-linear format for the equations, spending per student on vocational programs can be obtained simply by adding together the vocational and total spending variables.

The prime determinant of this measure of vocational spending is, in our opinion, likely to be the ratio of vocational enrollments to total enrollments. This reflects the types of budgetary pressures to which educators are typically compelled to respond. We expect to find, of course, that a higher percentage of students in vocational programs would be positively associated with the level of spending on vocational education.

Moreover, the vocational spending variable is likely also to be systematically related to the numbers enrollment of publicly enrolled students per capita, i.e., the enrollment rate. We would anticipate a positive relationship between vocational spending and the overall enrollment rate if, as we suspect, higher public school enrollments make tax payers more sensitive to student and family demands for different types of education. Undoubtedly, the tax payer is subject both to a conditioning process and to a public relations "sell" of educational programs. Our hypothesis is that vocational education spending is an appreciable benefactor of these phenomena.

Finally, in view of the proportionately large "outside" financial support for vocational education we expect *a priori* that intergovernmental fiscal transfers will have a telling place in the vocational spending equation. Thus, we have included, as two potential determinants of the proportion of current spending on vocational programs to total spending, the proportions of federal and of state aid which are allocated to the support of vocational education programs. We have employed proportions, rather than absolute levels of intergovernmental vocational aid in order to provide a better indication of the nature of educational budgetary decisions. We believe, of course, that the proportion of vocational spending will rise along with an increase in the proportion of state and federal educational aid in support of vocational programs.

These remarks suggest the following empirical specification for equation (2) which "explains" the proportion of educational spending going to vocational programs:

$$(2) \quad Y_4 = B + b_1Y_2 + b_2Y_5 + b_3X_{27} + b_4X_{28} + e_2$$

In this equation we expect all of the coefficients to be positive. In equation (2):

Y_4 = log of spending on vocational education as a proportion of total current spending on education;

Y_2 = log of publicly enrolled students per capita;

Y_5 = log of vocational enrollment as a proportion of total publicly enrolled students;

X_{27} = log of intergovernmental revenues received from the federal government to aid vocational programs as a proportion of total federal aid to education;

X_{28} = log of intergovernmental revenues received from the state government to aid vocational education as a proportion of total state aid to education; and

e_2 = random error term.

The Determinants of the Enrollment Rate -- A number of factors contribute to a determination of the number of students actually enrolled in public schools. Among these we have selected for inclusion in our "enrollment equation" a measure of the quality of public education, an indicator of the educational preferences of the people, evidence of a private budget constraint, the availability of alternative private educational opportunities, and, obviously, the size of the relevant age groups. Few would deny the probable significance of these factors. Yet it behooves us to elaborate on their hypothetical effects, mainly in order to bring some conjecture to bear on the anticipated direction of the influence of each of these on the overall enrollment rate.

Given the wide range of forces affecting public education expenditure decisions, observed differences in educational outlays per student may stem from a variety of causes. The response in public school enrollment to these differences in spending will depend on how people making enrollment decisions interpret them. Frequently, spending per student enrolled has been treated, with appropriate hedges about oversimplification, as an index of school quality.[21]

At any point in time, differences in spending per student among areas largely reflect differences in the range and level of specific educational services provided. The relationship of particular educational activities to output of the final product, namely educated students, is currently being debated.[22] Nevertheless, pending resolution of this issue, spending per student is an easily observed criterion which in reality should strongly influence a parents' evaluation of the quality of a school system.

In addition to influencing the choice of public versus private schooling, the quality of a school system may have an impact on enrollments by influencing the student attrition or dropout rate. This may be accomplished through the effects of "higher quality" education on the motivation of the potential dropout as well as through differences in the availability of specialized programs to deal with potential dropouts and to attract kindergarten entrants. The most important example of this is provided by the vocational education programs. They make the public school system relatively more attractive both to those who would drop out and to some of those who would contemplate attendance at private schools. The impact of these programs may also depend upon the availability of job opportunities, which in turn may be a function of size of the relevant labor market as well as of business conditions.

The level of parental education is likely to influence the school performance of a student.[23] The higher the levels of family educational attainment, the more likely that a greater value will be put on their children remaining in school. The public preference for private schooling may also be affected by family education, but the nature of this impact is ambiguous. All of these factors suggest the inclusion of median years of education of the adult population as an independent variable.

In the United States, the most frequent alternative to the public school system is that provided by parochial schools.[24] Religious affiliation clearly dominates many families' preferences for private education. In addition, areas with large agglomerations of people in a faith which supports private schools generally are more likely to offer these private educational alternatives. This effect in our model is measured by the percentage of the population in an area that is Catholic and by the percentage of the population that is Jewish, two religions which heavily support their own educational facilities.

To the degree that the private schools discriminate against nonwhites one would find comparatively higher public school enrollment in areas with a high percentage of nonwhites. In contrast, if nonwhites expect a lower return to education, they may be discouraged from staying in school. The inclusion of a variable on racial mix should pick up any significant net influence of these two counteracting tendencies.

The family budget constraint strongly influences the likelihood of choosing the relatively expensive education private schooling provides. However, the net effect of family income on public school enrollment is uncertain. As we know from casual observation, children from poorer families tend to drop out of school early,[25] perhaps due partly to the need for added family income. While the lifetime earning prospects of these dropouts are poor, the need for immediate income is often an urgent consideration. In order to capture these effects we include mean family income and the percent of families with income lower than $3,000 in the given year as independent variables.

The proportion of school-age children in the population will strongly affect the public school enrollment rate. Moreover, the total impact may be augmented insofar as the proportion of children in the population is positively correlated with average family size. A larger family with given income may find it too costly to choose private schooling. Finally, we expect that the age distribution within the school-age population would affect the enrollment rate since older children in high school have the highest attrition rate. Thus, in addition to the school-age population we also incorporate the percent of publicly enrolled students in high school as an explanatory variable.

The above discussion leads us to postulate a functional relationship in which the rate of enrollment in public education programs per school-age child is determined by several variables representing the quality of the school system, educational preferences of the population, the racial and religious breakdown of the population, the level and distribution of income, the age distribution of the school-age population, and the population size as a proxy for the available menu of occupational opportunities to graduates and nongraduates. Specifically, in equation (3) we hypothesize a log-linear relationship where:

$$(3) \quad Y_3 = C + c_1Y_1 + c_2Y_4 + c_3X_1 + c_4X_2 + c_5X_3 + c_6X_4 + c_7X_6 + c_8X_8 + c_9X_{14} + c_{10}X_{15} + c_{11}X_{16} + e_3.$$

In this equation:

Y_1 = log of current spending on education per publicly enrolled student;

Y_3 = log of publicly enrolled students per child aged 5-19;

Y_4 = log of spending on vocational education as a proportion of total current spending on education;

X_1 = log of money income per capita;

X_2 = log of percent of families with income less than $3,000;

X_3 = log of median years of school completed by the population over 25 years of age;

X_4 = log of percent of population that is nonwhite;

X_6 = log of population;

X_8 = log of percent of publicly enrolled students in high school;

X_{14} = log of percent of population that is Catholic;

X_{15} = log of percent of population that is Jewish;

X_{16} = log of children aged 5-19 years as a percent of total population;

e_3 = random error term.

Our expectation is that c_1, c_2, c_7, and c_{11} will be positive; c_8, c_9, and c_{10} will be negative; and that c_3, c_4, c_5, and c_6 may take on either sign.

The enrollment rate in the public school system per capita (Y_2) is an independent endogenous variable in equation (1). If the dependent variable in the enrollment equation -- equation (3) -- is to conform, it must be transformed to a per capita basis. Accordingly, we note as definitionally true that the enrollment rate per capita is equal to the product of the enrollment rate per school-age child and the ratio of the number of school-age children to the population. In terms of the notation above, where logs are used: $Y_2 = Y_3 + X_{16}$. Substituting into (3) we have equation (4), which we estimate using both 2SLS and OLS procedures.

$$(4)\quad Y_2 = C + c_1Y_1 + c_2Y_4 + c_3X_1 + c_4X_2 + c_5X_3 + c_6X_4 + c_7X_6 + c_8X_8 + c_9X_{14} + c_{10}X_{15} + c_{11}X_{16} + e_3.$$

The Determinants of the Enrollment Ratio in Vocational Education Programs -- The last equation in our simultaneously determined system is designed to explain the proportion of publicly enrolled students that participates in vocational education programs. This ratio apparently depends upon relative employment advantages of being "vocationally trained." In addition, we must try to assess the effects on the vocational enrollment ratio of the relative quality of vocational education offerings compared to those of education in general. Finally, we expect, not unnaturally, that there will be some influence attributable to the community's "tastes" for vocational education.

However, a simple quantifiable expression yielding relative economic opportunities to graduates of vocational programs is not easy to find. We have had to rely instead on a collection of explanatory variables. Thus, opportunities to be expected from completion of a vocational education program, in our model, are reflected by variables indicating relative demands for various occupations in the "local" labor market, variables describing the "local" industry mix, and the area's unemployment rate. The availability of reasonably priced higher, i.e., college-level, education, as approximated by state and local spending on higher education per capita, is also a relevant consideration.

The relative size of the vocational program, as well as the level of quality of the school system, may also influence relative enrollments in vocational education programs. These conditions are given in the vocational enrollment equation by the two endogenously determined variables: vocational spending in proportion to total educational spending and current educational spending per publicly enrolled student. Additionally, the "tastes" of the community for vocational education will vary with the level of income and educational attainment. (The industry mix variables might also serve as proxies for community preference for vocational education.) Finally, racial and religious mixes of the population are conceivable influences on "tastes" for vocational education.

The log-linear specification for the determinants of the enrollment proportion in vocational education programs is given by equation (5):

$$Y_5 = D + d_1Y_1 + d_2Y_4 + d_3X_1 + d_4X_2 + d_5X_3 + d_6X_4 + d_7X_6 + d_8X_8 + d_9X_{14} + d_{10}X_{15} + d_{11}X_{16} + d_{12}X_{17} + d_{13}X_{18} + d_{14}X_{19} + d_{15}X_{20} + d_{16}X_{21} + d_{17}X_{22} + d_{18}X_{23} + d_{19}X_{24} + d_{20}X_{25} + d_{21}X_{26} + e_4. \quad (5)$$

For this equation, we expect d_2, d_6, d_7, d_{11}, d_{13}, and d_{15} to be positive; and d_1, d_8, d_9, d_{10}, and d_{14} to be negative. The signs of d_3, d_4, d_5, d_{12}, d_{16}, d_{17}, d_{18}, d_{19}, d_{20}, and d_{21} are uncertain as they are subject to offsetting influences.

In equation (5):

Y_1 = log of current spending on education per publicly enrolled student;

Y_4 = log of total vocational spending divided by total current spending on education;

Y_5 = log of vocational enrollment divided by total public school enrollment;

X_1 = log of personal income per capita;

X_2 = log of percent of families with income less than $3,000;

X_3 = log of median years of education of those 25 years and older;

X_4 = log of percent nonwhite;

X_6 = log of population;

X_8 = log of percent publicly enrolled students in high school;

X_{14} = log of percent of population which is Catholic;

X_{15} = log of percent of population which is Jewish;

X_{16} = log of children aged 5-19 as percent of population;

X_{17} = log of percent of all workers classified as white collar;

X_{18} = log of percent of all workers classified as skilled;

X_{19} = log of percent of all workers classified as unskilled;

X_{20} = log of percent of all workers classified as service workers;

X_{21} = log of current expenditures on higher education per capita;

X_{22} = log of retail trade employees as a percent of total nonagricultural employment;

X_{23} = log of wholesale trade employees as a percent of total nonagricultural employment;

X_{24} = log of selected services employees as a percent of total nonagricultural employment;

X_{25} = log of manufactures employees as a percent of total nonagricultural employment;

X_{26} = log of the insured unemployment rate;

e_4 = random error term.

These four equations (1), (2), (4), and (5) constitute the essence of our base model. A total of twenty-six exogenous variables appears in them. In effect, these variables are taken to be "explained" outside of our theoretical system or model. In contrast, the set of equations attempts to specify the determinants of two spending variables and two enrollment variables. By treating the variables as endogenous explanatory variables it is explicitly hypothesized in the estimating equations that there is a mutual interaction among these variables. In consequence of this presumed simultaneity in the determination of the interrelationship among these variables we have estimated the equations' parameters using the two-stage least squares procedure, a statistically consistent estimating technique, as well as the ordinary least squares method. In our analysis of the results, to which we now turn, we will emphasize the estimates derived under 2SLS conditions.

X_{20} = log of percent of all workers classified as service workers;

X_{21} = log of current expenditures on higher education per capita;

X_{22} = log of retail trade employees as a percent of total nonagricultural employment;

X_{23} = log of wholesale trade employees as a percent of total nonagricultural employment;

X_{24} = log of selected services employees as a percent of total nonagricultural employment;

X_{25} = log of manufactures employees as a percent of total nonagricultural employment;

X_{26} = log of the insured unemployment rate;

e_4 = random error term.

These four equations (1), (2), (4), and (5) constitute the essence of our base model. A total of twenty-six exogenous variables appears in them. In effect, these variables are taken to be "explained" outside of our theoretical system or model. In contrast, the set of equations attempts to specify the determinants of two spending variables and two enrollment variables. By treating the variables as endogenous explanatory variables it is explicitly hypothesized in the estimating equations that there is a mutual interaction among these variables. In consequence of this presumed simultaneity in the determination of the interrelationship among these variables we have estimated the equations' parameters using the two-stage least squares procedure, a statistically consistent estimating technique, as well as the ordinary least squares method. In our analysis of the results, to which we now turn, we will emphasize the estimates derived under 2SLS conditions.

Part 3 -- Empirical Results for States, 1962

In Part 2 we have set forth the rationale for the empirical specification of the structural equations in our model of spending and enrollment in general education and in vocational education programs. It is readily apparent that there is assumed to be a simultaneous interaction among the spending and enrollment variables. This is reflected by the inclusion of the dependent variable of one equation as an endogenous variable among the explanatory variables of the other equations. The simultaneity property in the model compelled us to employ a two-stage least squares (2SLS) technique in estimating the parameters of the model. Since this technique takes simultaneity into account, it yields statistically consistent estimates of the parameters of the endogenous variables. We have also estimated the model using the ordinary least squares (OLS) statistical procedure. While the OLS estimates are not statistically consistent -- and in this respect inferior to 2SLS estimates -- they are presented and discussed in a comparative context.

We turn now to an examination and analysis of these two sets of estimates for each of the four equations already discussed. Emphasis will be put upon the "superior" estimates derived from the 2SLS procedure.

The Determinants of Current Spending per Student -- The alternative estimates of the determinants of current spending on education per student, i.e., equation (1), are given in Table 3-1. The estimates of Row 1 are for the complete four equation model outlined in Part 2 using 2SLS techniques. It can be seen that while the coefficient of the total enrollment variable (Y_2) is equal to almost twice its standard error, the regression coefficient of the vocational enrollment variable (Y_5) has a value which barely exceeds one standard error.[26] The negative coefficient of the enrollment per capita variable indicates that total current spending on education does not rise in proportion to enrollments. The fact that the absolute value of this coefficient is less than unity demonstrates that total current spending on education is a positive function of the enrollment rate.

The negative coefficient of the variable which measures the fraction of students enrolled in vocational programs is somewhat surprising, as vocational programs are supposedly more costly than educational programs in

Table 3-1
The Determinants of Current Educational Spending per Student (Y_1)*

	Y_2 = Publicly enrolled students per capita	Y_5 = Vocational enrollment divided by total public school enrollment	X_1 = Personal income per capita	X_2 = Percent of families with income less than $3,000	X_3 = Median years of education of those 25 and older	X_4 = Percent nonwhite	X_5 = Population density (per square mile)	X_6 = Population	X_7 = Average annual salary of instructional staff	X_8 = Percent of publicly enrolled students in high school	X_9 = Publicly enrolled students per operating school district	X_{10} = Estimated market value of taxable property per capita	X_{11} = Percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Intergovernmental revenue received from the state government for education per capita	X_{13} = Intergovernmental revenue received from the federal government for education per capita	Constant	S.E. & $\bar{R}^2$†
Row 1 4 equation 2SLS	-.63 (.33)	-.05 (.05)	.01 (.05)	-.02 (.13)	-.10 (.34)	-.001 (.03)	-.02 (.03)	.004 (.18)	.88 (.20)	.36 (.27)	-.04 (.02)	.13 (.09)	-.11 (.25)	-.001 (.02)	.05 (.08)	-4.09 (2.34)	.0886
Row 2 4 equation 2SLS	-.65 (.32)	-.04 (.05)	.002 (.21)	-.03 (.13)	-.11 (.33)	-.001 (.02)	-.02 (.03)	.004 (.02)	.88 (.19)	.36 (.27)	-.04 (.02)	.13 (.09)	-.10 (.25)	---	.05 (.08)	-3.99 (2.30)	.0869
Row 3 OLS	-.46 (.25)	-.01 (.04)	.05 (.20)	-.06 (.12)	-.20 (.33)	-.01 (.02)	-.01 (.03)	.01 (.02)	.89 (.19)	.32 (.26)	-.05 (.02)	.12 (.08)	-.12 (.24)	.0007 (.02)	.06 (.08)	-3.53 (2.24)	.0859 .866
Row 4 OLS	-.46 (.24)	-.01 (.04)	.05 (.19)	-.06 (.12)	-.20 (.32)	-.01 (.02)	-.01 (.03)	.01 (.02)	[illegible] (.18)	.32 (.26)	-.05 (.02)	.12 (.08)	-.12 (.23)	---	.06 (.07)	-3.53 (2.21)	.0846 .870
Row 5 Partitioned 2SLS	-1.12 (.39)	---	-.14 (.23)	-.10 (.12)	-.10 (.36)	.01 (.03)	-.04 (.03)	-.001 (.03)	.82 (.21)	.32 (.29)	-.03 (.02)	.15 (.09)	.03 (.27)	.01 (.02)	.03 (.09)	-3.39 (2.37)	.0937
Row 6 Partitioned 2SLS	-1.12 (.38)	---	-.15 (.22)	-.10 (.12)	-.11 (.35)	.01 (.34)	-.05 (.03)	-.003 (.02)	.84 (.20)	.31 (.28)	-.03 (.02)	.15 (.09)	.02 (.26)	---	.02 (.08)	-3.32 (2.34)	.0925
Row 7 Partitioned OLS	-.48 (.24)	---	.04 (.19)	-.07 (.11)	-.21 (.32)	-.01 (.02)	-.01 (.03)	.01 (.02)	.88 (.19)	.31 (.26)	-.05 (.02)	.12 (.08)	-.11 (.23)	.002 (.02)	.06 (.08)	-3.41 (2.14)	.0847 .870
Row 8 Partitioned OLS	-.47 (.23)	---	.04 (.19)	-.07 (.11)	-.21 (.31)	-.01 (.02)	-.01 (.03)	.01 (.02)	.89 (.18)	.31 (.25)	-.05 (.02)	.12 (.08)	-.11 (.21)	---	.06 (.07)	-3.40 (2.10)	.0835 .873

* The top figure in each row is the regression coefficient. Its standard error is given in parentheses. All variables are expressed in logs to the base 10.

† In presenting our results from 2SLS estimation we have deliberately omitted the R^2, and F-tests related to it, for reasons discussed in R. L. Basmann, "Letter to the Editor," *Econometrica* (October, 1962). For 2SLS the R^2 may range from $-\infty$ to $+1$ and its traditional interpretation is misleading. Even for an OLS estimate of a reduced-form equation the usefulness of the R^2 is severely limited as its distribution depends in a complex fashion on the coefficients one is estimating.

In those rows with two figures in this column, the standard error of the regression estimate is on top: the adjusted coefficient of determination is beneath.

general. It should be noted, however, that this coefficient is very close to zero. Below, we show that total spending on vocational programs per student is positively related to the fraction of vocational enrollments, with an elasticity of less than one. Thus, it appears that while vocational spending rises with the fraction of students enrolled in vocational education, it does not do so proportionately. In addition, spending on other programs is evidently reduced approximately dollar for dollar.

Hence, our best estimate indicates that educational spending per student is negatively related to the total enrollment rate, but that it is not significantly affected by the proportion of vocational enrollments.

From the estimates given in Row 1, it is apparent that only two exogenous variables exhibit regression coefficients that are at least 1.5 times their standard errors.[27] These are the variables measuring average teachers' annual salaries (X_7) and average size of operating school districts (X_9).[28] The size of the coefficient of the teachers' salary variable implies that a ten percent increase in average teachers' salaries results in a slightly less than ten percent (8.8 percent to be concrete) increase in spending per student. Interpretation of this finding is of some significance. It indicates that while there is some substitution of other educational inputs for instructional staff when teachers' salaries rise -- a typical cost-saving device which one would expect to find important in view of the relatively large bulk[29] of the salary item in school budgets -- the degree of substitution does not appear to be substantial. Moreover, the estimates are not inconsistent with the hypothesis that the budgetary impact of higher teachers' salaries is <u>not</u> appreciably reduced by a significant compensatory change in teacher-student ratios. Therefore, we must conclude that some of our <u>a priori</u> apprehensions about the effects of larger teachers' salaries on a rough measure of educational quality are, on the basis of this evidence, somewhat excessive.

From the results of including the second statistically significant exogenous variable we derive evidence of economies of scale, insofar as district size rather than school size is considered to be the "unit of account." As can be seen from the coefficient of the district size variable (X_9), current educational spending per student drops by .04 percent for every one percent increase in the number of students encompassed by an operating school district.

From this we cannot appropriately infer, however, that there are scale economies in teaching <u>per se</u>, although this may well be the case. Possibly there are classroom scale economies, or even school scale economies. But the evidence here is also consistent with economies of scale in the administration of school districts. Much more evidence is needed before the bases of the scale economies shown by equation (1) can be sorted out. The absolute size of the parameter suggests, however, that the budgetary economies of increasing district size are not substantial.

It should finally be pointed out that, irrespective of our a priori reasoning presented in Part 2, no other potentially important explanatory variable turned out to be statistically significant for the 1962 state cross-sectional sample. The closest to being so was the percent of publicly enrolled students that is attending high school (X_8).[30] The fact that the sign of the coefficient of this variable accords with our theoretical notions makes it tempting to draw inferences about the relationship between this variable and per student spending, and the absolute size of the regression coefficient reinforces this temptation. Nevertheless, on purely statistical grounds, although we were in no sense scientific in choosing our cut-off for the ratio of the regression coefficient to its standard error, we must resist this temptation.

Estimates of a variant of our basic model are presented in Row 2 of Table 3-1. For the equation estimated there, the variable which measures state aid to local school systems has been eliminated. The rationale for dropping this variable from the spending equation is that given the same level of aggregation for the dependent variable and for the aid variable, one conceivably could be estimating the dependent variable with one of its own definitional components. From what is known of the local nature of the decision making process in education, this possibility seems remote. Nevertheless, we felt it prudent to estimate an alternative simultaneous equations system with the state aid variable removed. As can be seen from the estimates of Table 3-1, however, the removal of this variable does not significantly alter the estimated coefficients for the remainder of the variables.

In Rows 3 and 4 of Table 3-1 we have entered the OLS estimates which are comparable to the 2SLS estimates cited in Rows 1 and 2. While the OLS estimates are not statistically consistent, they are not totally meaningless. Moreover, in a small sample, the smaller variance of an OLS estimator, compared to that of the 2SLS procedure, may be sufficient to offset its bias. Therefore, a particular OLS estimate may be closer to the true parameter value than that derived using 2SLS.[31] The point estimates of some coefficients, especially between those of the endogenously determined variables differ between the OLS and the 2SLS formulations. Moreover, where estimates of the coefficients of any of the other explanatory variables are appreciably different under the OLS procedure, they have typically increased in absolute value, but the signs are consistent between OLS and 2SLS estimates. This is as it should be, given the fact that the OLS estimating technique fails to consider simultaneity among the dependent variables and the endogenous variables. Failure to do this has cut substantially the presumed impact of the endogenous variables -- the two sets of enrollment data -- and increased the influence of several other explanatory variables, notably personal income per capita (X_1), the income distribution variable (X_2), educational attainment (X_3), and the racial mix (X_4), although none of these variables is statistically significant given our assumed cut-off at 1.5 times the standard error for the regression coefficient. Still, even though there are differences between the OLS and 2SLS estimates, especially for the coefficients of the endogenous variables, the qualitative interpretation given above, when Row 1 figures were discussed, remains valid.

The Partitioned Model -- It has been noted above that current educational spending per student appears to be independent of the ratio of vocationally enrolled students to total enrollments in public schools. Our analysis of the determinants of public school enrollment rates, given subsequently, will show a similar conclusion: Relative spending on vocational education has little impact on the public school enrollment rate, although it does affect the proportion of students that is enrolled in vocational programs.

It should not be surprising that total spending is not significantly influenced by the fraction of vocational students, and that the flexibility exists to substitute vocational spending for other spending, dollar for dollar, since vocational spending is only about two percent of total educational spending across states. Moreover, given that vocational enrollment is only ten percent of total enrollment, and approximately only one-half of these are daytime enrollments, there is little leverage with which vocational enrollments can have an appreciable impact on total spending. In the same way, given the relatively small average size of vocational programs, it is a likely possibility that vocational spending will have little impact on total public school enrollment rates.

These results suggest that it may be possible to partition the four equations of the basic model into two halves to be estimated separately. The spending per capita and enrollment rate equations would not include the measures of proportionate vocational enrollments and vocational spending as independent variables. This also implies that the set of exogenous variables to be used in estimating equations (1) and (2) would be that found in the first two equations -- not those in all four equations. For the partitioned version of the basic model the equations for vocational spending and enrollments are estimated while treating current spending per student and the public school enrollment rate as exogenous.

The results for the total educational spending equation, estimating the partitioned model by 2SLS, are given in Rows 5 and 6 of Table 3-1. Substantial differences in the estimates of the coefficients of the enrollment variable, as compared to the results of Rows 1 and 2, are the only variations of consequence. As there are two factors which differentiate the estimates in Rows 5 and 6 from those in Rows 1 and 2 -- the elimination of the vocational enrollment proportion variable as well as the use of a smaller set of instrumental variables -- we standardized for one of these factors in order to isolate the cause of this different impact of the total enrollment rate. In particular, we reran the educational spending equation in the partitioned model -- we re-estimated Rows 5 and 6 -- using twenty-eight and twenty-six instrumental variables respectively. (These re-estimates are not shown here.) The re-estimated coefficients of the enrollment rate variable were -.74 in each case, indicating that the difference in instruments is the source of approximately eighty percent of the change in the estimate.[32]

After correcting for this statistical effect, the partitioned model gives an impact from changes in the enrollment rate of -.90. It is probable that this revised figure does not differ significantly from -1.0, so that for all intents and purposes we have derived a unitary elasticity relationship between educational spending per student and the total enrollment rate. The larger absolute values of the enrollment rate coefficients of Rows 5 and 6, compared to the basic model estimates of Rows 1 and 2, indicate less of a tendency for spending per student to rise as the enrollment rate increases. Since there is no *a priori* "correct" set of instrumental variables, we can only conclude that the partitioned model implies an educational budget which may well be largely invariant to changes in the total enrollment rate. This differs from our results from the basic model, wherein we found a positive relationship between the current level of spending and the enrollment rate.

Finally, the last two rows of figures in Table 3-1, Rows 7 and 8, provide regression estimates for the partitioned model using OLS procedures. It will be observed that these estimates do not differ greatly from the OLS estimates of the basic model, Rows 3 and 4. Since OLS estimation ignores feedback effects from the endogenous explanatory variables this outcome is not unreasonable. Dropping the vocational enrollment proportion from among the explanatory variables should have no appreciable impact when this variable was found in the basic model to be statistically insignificant and when interactions among the variables are discounted completely.

<u>The Determinants of the Enrollment Rate in Public Education</u> -- We have just discussed our several estimates of the parameters of the per pupil current spending equation, in which we observed that only three variables -- the enrollment rate, an endogenous factor in our basic model, and average teachers' salary and size of the school district -- are significant determinants by the statistical standard we have adopted. Given that our *a priori* notions led us to include a total of fifteen explanatory variables in the spending equation it was a disappointment to find that the actual data were supportive of our expectations in only three instances. Moreover, because the 2SLS estimating procedure yields a coefficient of determination ($\bar{R}^2$) of questionable interpretation we cannot be certain of the quality of our ability to "explain" the over-all variance of current expenditures per student in public schools by the factors expressed in equation (1). However, interpretation of the coefficient of determination in the OLS estimates is more straightforward. Here, we note that our various OLS estimates of equation (1), in which the parameter estimates were not inconsistent with those derived from 2SLS procedures, yield coefficients of determination of approximately .87. Thus, in this estimating variant of the basic model, the quantification of our theoretical expectations has resulted in the explanation of about eighty-seven percent of the state-by-state variation in current educational spending per student in 1962.

Table 3-2 presents a corresponding set of statistical estimates of the parameters of equation (4) of Part 2, which was designed to ascertain the determinants of enrollment per capita in the public elementary and secondary schools. We should perhaps note at the outset that our OLS estimates of the determinants of the enrollment rate permit us to explain seventy-four percent of the state-by-state variation in the public school enrollment rate. Thus, our record in predicting enrollment rates, given the values of the several explanatory variables, should be slightly inferior to our ability to predict per pupil current spending, even though in the estimated equation explaining the over-all enrollment rate we find that a larger fraction of the potential explanatory variables is statistically significant. Thus, seemingly more phenomena are responsible for determining an over-all enrollment rate than the level of per pupil spending in the several states, and even so we account for a smaller portion of the state-by-state variation in enrollment per capita.

From the parameters recorded in Table 3-2, Row 1, which are based on 2SLS estimates of the complete four equation model, it is apparent that those explanatory variables which exert the most significant impact on the public school enrollment rate reflect the quality of education (as represented by per student spending), the educational attainments of the adult population, the age distribution of the population, the proportion enrolled in high school, and a religious mix factor. Thus, more than fifty percent of our presumed explanatory variables were found to have a statistically significant influence on enrollment per capita, which is a distinct improvement over this measure of our success rate in the case of "explaining" state-by-state per pupil spending variations.

The sign of the regression coefficient on the per student spending variable (Y_1) is, of course, as we had expected: greater current educational outlays per student lead to a higher public school enrollment rate, although the quantitative magnitude of this relationship is not particularly large. It is comforting to find in our more intricate model of the relationship between spending per pupil, educational quality, and the enrollment rate that findings derived from the Gustman-Pidot model are not refuted. Although the impact is not especially large, students do seem to gravitate toward school systems that offer better educational experiences insofar as these are measured by current educational spending per student. However, our estimate of the size of the impact of changes in spending per student on the enrollment rate is undoubtedly affected by the presence of interdependence among the endogenous explanatory variables.[33] As noted below, re-estimation of the enrollment rate equation, after the removal of the variable for the proportion of current spending which is allocated to vocational programs (Y_4), results in a substantial increase in the estimate of the per student spending coefficient and in increasing confidence in its statistical significance.

A higher level of education among those members of the population aged 25 and over (X_3) results in a larger school enrollment rate. This relationship is as expected, and has been carefully documented in previous research.[34] However, it should be acknowledged that this relationship, since we are explaining public school enrollment per capita, is no doubt due to a blending of factors. It reflects in part the positive correlation between educational attainment and aspirations for one's children; in

Table 3-2
Determinants of Public School Student Enrollment per Capita (Y_2)*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total spending on current education	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent of population which is nonwhite	X_6 = Log of population	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	Constant	$\frac{S.E.}{\bar{R}^2}$
Row 1 4 equation, 2SLS	.19 (.13)	-.03 (.03)	-.17 (.13)	.01 (.07)	.28 (.18)	.016 (.013)	-.015 (.014)	-.46 (.21)	-.05 (.02)	-.04 (.01)	.16 (.10)	-.77 (1.20)	.0623
Row 2 4 equation, 2SLS	.21 (.13)	-.04 (.04)	-.17 (.14)	.01 (.07)	.27 (.18)	.015 (.013)	-.016 (.015)	-.48 (.21)	-.06 (.02)	-.038 (.014)	.18 (.11)	-.83 (1.21)	.0627
Row 3 OLS	.13 (.11)	-.03 (.03)	-.15 (.13)	.01 (.06)	.32 (.17)	.017 (.013)	-.014 (.014)	-.42 (.20)	-.05 (.02)	-.04 (.01)	.15 (.10)	-.77 (1.19)	.0620 .738
Row 4 OLS		SAME AS ROW 3											
Row 5 Partitioned, 2SLS	.33 (.17)	--	-.24 (.14)	-.01 (.06)	.22 (.19)	.012 (.014)	-.013 (.014)	-.56 (.23)	-.06 (.02)	-.04 (.01)	.18 (.11)	-.43 (1.20)	.0642
Row 6 Partitioned, 2SLS		SAME AS ROW 5**											
Row 7 Partitioned, OLS	.15 (.11)	--	-.17 (.13)	-.01 (.06)	.32 (.17)	.017 (.013)	-.011 (.014)	-.42 (.20)	-.05 (.015)	-.04 (.014)	.13 (.10)	-.51 (1.16)	.0620 .738
Row 8 Partitioned, OLS		SAME AS ROW 7											

* Standard errors are given in parentheses.
** Differs only in the third place in the regression coefficient estimates.

part it mirrors the likely positive correlation between educational attainment and attendance at private, as opposed to public schools (the influence of the religious mix has been netted out by the statistical estimating procedure); and in part it reflects the relationship between educational attainment and family size. Thus, while the sign of the educational attainment variable conforms to our "theoretical" insight, it must be confessed that this expectation was determined largely by our knowledge of previous empirical results rather than by a priori considerations per se.

Likewise, the sign of the coefficient of the variable showing the proportion of total student enrollments that is in high schools (X_8) is not surprising. A greater proportion of public secondary school students is associated with a lower enrollment rate. That high school students have by far the highest drop-out rate is undoubtedly a major factor in establishing the negative relationship between proportions of students in high school and the over-all enrollment per capita.

While, as suggested above, other phenomena have an influence on whether or not school-aged children attend public or private schools, the availability of private schools and the fact that religious inclinations affect both the existence of private (parochial) schools and the public-private education choice cannot be discounted in ascertaining the crucial determinants of public school enrollment rates. Thus, it is reassuring to observe that our model eventuates in a negative (net) relationship between the over-all public school enrollment rate and the percent of the population that is Catholic (X_{14}) and the percent that is Jewish (X_{15}) -- both religious groups in our society that relatively heavily support non-public education at the elementary and secondary levles. The signs of the parameters of these two religious mix variables are consistent with our expectation, based on "casual empiricism," that children of these two groups are more likely to attend private schools than is the case of those of the public at large, although again relative family size is probably responsible for some unspecified portion of the influence. Consequently, a higher percent of Catholics or Jews in a given state's population, our results show for 1962, is significantly associated with a lower public school enrollment rate.

Finally, our statistical findings show only a slight positive effect of the percent of school-aged children in the population as a whole on the public school enrollment rate, and this relationship, by our criterion, is a statistically significant one. The relationship implies that an increase of ten percent in the proportion of the population that is of school age will result in merely an increase in the enrollment rate of 1.6 percent! This, of course, leads us to wonder what has happened to those additional children who apparently do not find their way into the public schools. In other words, that the coefficient of the school-age proportion variable is so far below 1.0 is a surprising result and inconsistent with our a priori expectations. One must probably look outside of theoretical arguments to find a rationalization of this unexpected result. A possible explanation is purely statistical in character: The proportion of the population that is of school age is a variable which demonstrates very little independent variation from state to state.[35] This small relative variation is likely to yield a comparatively poor statistical fit and this, rather than some unrecognized "real" relationship, may be largely responsible for the very small quantitative impact (whose "direction" or sign is as we anticipated) of the proportion of school-aged children on the enrollment rate.

The estimates cited in Table 3-2, Row 2, differ from those found in Row 1 in that the data for the two endogenous explanatory variables, current spending per publicly enrolled student (Y_1) and spending on vocational programs relative to total current spending on education (Y_4), are derived using a different set of instrumental variables. The series for Row 1 were determined with the state aid variable affecting the data, whereas for the Row 2 estimates the state aid variable was dropped from among the estimating instruments. This use of a smaller set of exogenous variables apparently had little impact on the parameters of the enrollment equation and so there is no discussion of the interpretation of the several coefficients. Rather, our comments concerning the estimates given in Table 3-2, Row 1, will serve nicely.

Similarly, the two sets of OLS estimates of the determinants of enrollment per capita, Rows 3 and 4, are not noticeably different from the 2SLS estimates. In fact, the OLS estimates with the influence of the state aid discounted, Row 4, do not diverge from those derived from the full set of relevant exogenous variables, Row 3. For those variables in which the parameters differ appreciably between the OLS and 2SLS estimates, we find that the standard errors are relatively large enough to discredit the statistical significance of the estimated regression coefficients. Again, then, an articulation of the qualitative nature of the relationship between the several explanatory variables, on the one hand, and the enrollment rate, on the other, would add nothing to the commentary we have already given.

Table 3-3
The Determinants of Percent Spending on Vocational Education*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	X_{27} = Log of federal spending on vocational education as a percent of federal spending on education	X_{28} = Log of state spending on vocational education as a percent of state spending on education	Constant	S.E. / $\bar{R}^2$
Row 1 4 equation, 2SLS	1.11 (.40)	.53 (.13)	.32 (.09)	.10 (.04)	-1.59 (.52)	.2596
Row 2 4 equation, 2SLS	.84 (.41)	.64 (.12)	.35 (.10)	--	-1.76 (.55)	.2769
Row 3 OLS	1.03 (.36)	.50 (.11)	.32 (.09)	.10 (.04)	-1.77 (.50)	.2590 .668
Row 4 OLS	.79 (.38)	.61 (.11)	.35 (.10)	--	-1.92 (.53)	.2763 .621
Row 5 Partitioned, 2SLS	1.10 (.39)	.47 (.14)	.33 (.09)	.10 (.04)	-1.77 (.50)	.2593
Row 6 Partitioned, 2SLS	.85 (.40)	.57 (.14)	.36 (.10)	--	-1.93 (.53)	.2767
Row 7 Partitioned, OLS		SAME AS ROW 3				
Row 8 Partitioned, OLS		SAME AS ROW 4				

* Standard errors of the regression coefficients are given in parentheses.

The Partitioned Model -- In contrast to the results for the full multiple equation model, the change in specification associated with partitioning the model (Row 5) has a clearer impact on the coefficient of the per pupil spending variable (Y_1). In the case of the enrollment rate relationship, as with that for the spending equation, the difference is attributable to the use of a subset (rather than the complete set) of instrumental variables, and not to the elimination of the appropriate vocational variable, in this instance the proportion of total current educational spending devoted to vocational programs. It should also be noted, of course, that for the partitioned model there is a relatively substantial difference between the OLS (Rows 7 and 8) and the 2SLS (Rows 5 and 6) estimates of the regression coefficient of the endogenous independent variable (Y_1), with the impact of the variable being slightly more than halved when feedbacks are not permitted in the estimating process. This change in the regression coefficient is again consistent with _a priori_ notions: since per pupil spending and enrollment rates are observed to be positively related, failure to account for interactions between them should reduce the quantitative impact to some degree. Nevertheless, it is surprising that this reduction should be so large in the case of the enrollment equation.

The Determinants of the Proportion of Current Spending Going into Vocational Education Programs -- Our estimates of equation (2) of Part 2 are presented in Table 3-3. The signs of all of the regression coefficients are compatible with theoretical reasoning, and for this equation, unlike the preceding two, every one of the estimated coefficients is in excess of twice its standard error. Thus, all of the regression coefficients are statistically significant, even by the conventional cut-off ratio between the coefficient and its standard error.

If we look first at the regression coefficients derived for the vocational enrollment variable (Y_5) we can justifiably infer that the vocational education budget does not vary in proportion to vocational enrollment as a percent of over-all enrollment. The proportion of total current educational spending devoted to vocational programs rises, rather, approximately by only one percent for each two percent increase in the fraction of students who are participating in vocational programs.[36] This is indicated in _Row 1_, for example, by the coefficient of .53. In addition, we observe that school districts with higher over-all enrollment rates appear to allocate a larger fraction of their total spending to vocational education. (The coefficient for Y_1 is 1.11.) In analyzing the variation in total vocational spending per student enrolled in public schools, however, it must be remembered that current educational spending per pupil declines when total school enrollment does so. Thus, while a higher school enrollment raises the fraction of total spending devoted to vocational education, it is associated with a decrease in spending per student. This adjustment leaves in doubt the net impact of the total enrollment rate on spending on vocational education per student.

This can be described in symbolic terms for the log-linear specifications defined in Part 2, holding everything else constant:

$$Y_1 = a_1 Y_2 + Z_1,$$

$$\text{and } Y_4 = b_1 Y_2 + Z_2,$$

where Z_1 and Z_2 are vectors of constants. The log of total spending on vocational education per public school student is given by:

$$Y_1 + Y_4 = Z_1 + Z_2 + (a_1 + b_1)Y_2.$$

For the full four-equation model we have ascertained a_1 to be -.6 and b_1 to be 1.11. Thus, in accordance with these results, spending on vocational education apparently increases by roughly one percent for every two percent expansion in total enrollments.

However, we noted in our discussion of the determinants of the over-all enrollment rate that there is a substantial difference in the estimates of a_1 obtained from the full four-equation and from the partitioned models. In particular, a_1 is estimated as -1.1 in the partitioned model. In this instance, the estimate of a_1 is equal in absolute size to b_1, but their signs are opposite. (Note that the estimate of b_1 is essentially unaffected by the partitioning process.) This result, contrary to that above, implies that the level of spending per student on vocational education programs is not influenced by the over-all enrollment rate of students; for although the fraction of total spending on vocational education rises with total enrollments, outlays per student fall proportionately with the increase in enrollments -- leaving vocational spending per student basically unchanged.

If the correct answer lies somewhere between the results derived from the full model and the partitioned model, then spending per student on vocational education increases by a small fraction as the total enrollment rate rises; it also expands less than proportionately with increases in the percent of over-all enrollments in vocational education programs.

Turning to the strictly exogenous variables in equation (2) we notice that the regression coefficients for both the federal and state aid variables are positive and significantly different from zero. Since state expenditures accounted for over one-third of total vocational spending, while federal aid accounted for slightly less than one-fifth of the total,[37] it seems that state and federal aid to vocational education clearly stimulate spending on these programs. However, it should be noted that there is also some fungibility in monies available to school districts, whereby localities substitute outside aid for locally generated funds which would have been committed to expenditures on vocational education with or without federal and state assistance.

In scanning the estimates listed in Table 3-3 it is apparent that the deletion of the state aid variable (X_{28}) results in only one major change in the estimated parameters of the other independent variables. With state aid deleted, that is, the value of the coefficient of the total enrollment variable (Y_2) falls by approximately thirty percent. The resulting partitioned model estimates are closer in absolute value to the estimated coefficient of Y_2 in equation (1) of Part 2 (see Table 3-1), leading again to an interpretation in which vocational outlays per student are virtually invariant with respect to the overall enrollment rate.

As a final comment on the data of Table 3-3 we should mention that the partitioned model and OLS estimating procedures yield little difference in results than those derived from the full four-equation model when a statistically consistent estimating technique was employed. The OLS parameter estimates for the endogenous variables are slightly lower, but not substantially so, than the commensurate coefficients from the 2SLS estimates when the model is not partitioned; there is no difference at all in the values of the exogenous variables' coefficients. In the partitioned model, the OLS estimates of the coefficient of Y_2 are lower than the 2SLS estimates when the state aid variable is included, but higher when state aid is deleted from the estimated equation. For the vocational enrollment proportion variable, however, the OLS estimates are in both cases slightly higher, while there is very little disparity in the coefficients derived for the exogenous variables. Over-all, though we have not made the indicated precise statistical determination, these differences are probably insignificant.

<u>The Determinants of Relative Enrollment in Vocational Education Programs</u> -- In Part 2 we discussed the presumed bases by which the proportion of total publicly enrolled students that participate in vocational programs can be

explained. This discussion culminated in the specification of equation (5), which contains twenty-one explanatory variables, two of which are endogenously determined in our model. The 2SLS estimates of the parameters of this equation are found in Table 3-4, Row 1. It appears, for the complete four-equation model, that six independent variables exhibit a notable statistical relationship to the dependent variable, the ratio of vocational to total enrollments (Y_5). In addition to the endogenous variables, current spending per publicly enrolled student (Y_1) and the ratio of spending on vocational programs to total current educational expenditures (Y_4), the variables which measure per capita income (X_1), percent Catholic (X_{14}), percent unskilled workers (X_{19}), and percent manufacturing employees (X_{25}) all have coefficients which exceed 1.5 times their standard error. Thus, something less than one-third of the variables we thought would be meaningful determinants of the vocational education enrollment ratio in fact turned out to be salient.

Examining Row 1 we observe that the elasticity of the ratio of vocational enrollments with respect to the ratio of vocational spending to over-all current educational outlays is .53. The arithmetic means of these two variables are .10 and .02 respectively. Thus, a one percentage point increase in the ratio of vocational to total current spending (.01), which represents a very substantial expansion of 50 percent in the ratio, would lead to an increment in the vocational enrollment fraction of approximately 25 percent, or .025. By adding the parameter estimates for equations (2) and (5), along the lines suggested in the preceding section, it can be shown also that enrollment in vocational programs per capita will rise by one percent for each two percent increase in the fraction of spending going into vocational programs. Thus, there is a significant interaction between vocational enrollment ratios and the proportions in budgetary allocations that should be considered in educational planning.

The elasticity of the fraction of vocational enrollment with respect to current spending per student on education (Y_1) is 1.08. When the estimates of equations (1) and (5) are added so as to isolate the determinants of vocational spending per publicly enrolled student, the coefficient rises to 1.27, i.e., 1.08 + .19. These figures indicate, therefore, a degree of responsiveness of vocational enrollments to expenditure patterns. An expansion of one percent in current educational outlays per student, which amounts to an increment of $3.66 per student using 1962 state averages, results in a 1.27 percent increase in vocational enrollment per capita.

As for the exogenous variables, higher per capita income (X_1) is associated with lower relative vocational

Table 3-4
The Determinants of Vocational Enrollment
as a Percent of All Publicly Enrolled Students (Y_5)*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent of population that is nonwhite	X_6 = Log of population	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population
Row 1 4 equation, 2SLS	1.08 (.65)	.53 (.18)	-1.37 (.77)	.19 (.43)	.65 (1.14)	.03 (.07)	-.01 (.08)	.65 (1.02)	-.13 (.08)	.09 (.07)	.52 (.55)
Row 2 4 equation, 2SLS	1.03 (.67)	.55 (.20)	-1.35 (.78)	.17 (.43)	.68 (1.16)	.04 (.07)	-.01 (.08)	.65 (1.02)	-.12 (.08)	.09 (.07)	.49 (.56)
Row 3 OLS	1.62 (.52)	.63 (.15)	-1.61 (.74)	.22 (.41)	.79 (1.10)	.03 (.07)	-.02 (.07)	.28 (.97)	-.15 (.07)	.09 (.07)	.68 (.52)
Row 4 OLS			SAME AS ROW 3								
Row 5 Partitioned, 2SLS	1.40 (.57)	.38 (.23)	-1.50 (.78)	.30 (.44)	.34 (1.20)	.01 (.07)	-.03 (.08)	.66 (1.05)	-.17 (.08)	.09 (.07)	.73 (.54)
Row 6 Partitioned, 2SLS	1.01 (.78)	-.10 (.42)	-1.28 (1.04)	.45 (.58)	-.50 (1.55)	-.02 (.10)	-.05 (.10)	1.38 (1.45)	-.19 (.10)	.08 (.10)	.82 (.72)
Row 7 Partitioned, OLS			SAME AS ROW 3								
Row 8 Partitioned, OLS			SAME AS ROW 3								

	X_{17} = Log of percent of all workers classified as white collar	X_{18} = Log of percent of all workers classified as skilled	X_{19} = Log of percent of all workers classified as unskilled	X_{20} = Log of percent of all workers classified as service workers	X_{21} = Log of current expenditures on higher education per capita	X_{22} = Log of retail trade employees as a percent of total nonagricultural employment	X_{23} = Log of wholesale trade employees as a percent of total nonagricultural employment	X_{24} = Log of selected services employees as a percent of total nonagricultural employment	X_{25} = Log of manufactures employees as a percent of total nonagricultural employment	X_{26} = Log of the insured unemployment rate	Constant	S.E. / R^2
Row 1 4 equation, 2SLS	-1.42 (1.09)	1.13 (.89)	-1.00 (.63)	.35 (.67)	.29 (.20)	.36 (.91)	.29 (.34)	.25 (.32)	.37 (.23)	-.21 (.18)	-.23 (9.09)	.2527
Row 2 4 equation, 2SLS	-1.38 (-1.10)	1.08 (.91)	-.97 (.64)	.35 (.67)	.29 (.20)	.39 (.92)	.28 (.34)	.23 (.33)	.37 (.23)	-.20 (.18)	-.19 (9.10)	
Row 3 OLS	-1.67 (1.04)	1.20 (.85)	-.98 (.60)	.04 (.63)	.24 (.19)	.21 (.88)	.33 (.33)	.33 (.31)	.35 (.22)	-.22 (.17)	1.25 (8.84)	.3463 / .672
Row 4 OLS												
Row 5 Partitioned, 2SLS	-1.73 (1.10)	1.48 (.92)	-1.24 (.66)	.46 (.71)	.30 (.20)	.15 (.93)	.33 (.35)	.34 (.33)	.43 (.24)	-.26 (.18)	-.67 (9.40)	.2694
Row 6 Partitioned, 2SLS	-1.84 (1.45)	2.02 (1.25)	-1.73 (.91)	1.24 (1.05)	.39 (.28)	.04 (1.23)	.33 (.45)	.35 (.43)	.58 (.33)	-.34 (.24)	-4.24 (12.56)	.3424
Row 7 Partitioned, OLS												
Row 8 Partitioned, OLS												

* Standard errors of the regression coefficients are given in parentheses.

enrollments. The same "directional" relationship is seen to be true of the effect of the percent of Catholics (X_{14}) in a state's population. Since we can view income per capita as a measure of economic advancement, we note that vocational educational programs are inferior goods, in the conventional sense that rising income seems to reduce the quantity of vocational education desired by the public. One can interpret the religious mix variable as an index of family background, in which case the negative relationship may be somewhat surprising. However, since we are attempting to explain vocational enrollment ratios in public schools, and recalling that the religious mix factor was a significant negative determinant of public school enrollments, we may see, in this particular percent Catholic-vocational enrollment ratio response, a situation in which students oriented toward vocational education are drawn out of public schools to a relatively greater extent than private schools skim off students in general. Or put another way, a disproportionately large number of students who attend private schools, had they not done so, would have been enrolled in public school vocational education programs. The empirical support for this hypothesis is at best weak, but it does not seem inconsistent with the findings cited in Table 3-4.

We observe, moreover, interesting relationships between the vocational enrollment ratio and the percent of the working force that is unskilled (X_{19}), on the one hand, and the ratio of employees in manufacturing to total non-agricultural employment (X_{25}), on the other. The former relationship is inverse, while the latter is positive. In our view, the unskilled component of the working force is a proxy for occupation mix, whereas the manufacturing employment ratio is an index of industry mix. That is to say, these two variables are a measure of relative demands for the graduates of vocational education programs. Given this interpretation, it is not unreasonable to expect the relationships that have been generated by the 1962 state cross-section. Unskilled labor does not normally require vocational training and, therefore, a relatively high proportion of unskilled laborers in the work force should be negatively associated with a high ratio of vocational enrollment to total enrollment. Similarly, the manufacturing sector demands a relatively skilled labor force so that we should anticipate a positive relationship between the extent of manufacturing in a state and the ratio of vocational enrollments. Note, however, that the percent of the labor force in manufacturing activities may also be a proxy for level of over-all economic development in a state. If this is so, we would expect this variable and the income per capita variable to have the same sign. Since they do not, in our view then, the percent of manufacturing employees is more properly a measure of industry mix.

Turning to other rows in Table 3-4, we notice that the impact of removing the state aid variable (Row 2) and of using the instruments of the partitioned model (Rows 5 and 6) appears to be complex. In the integrated four-equation model, the coefficients of the spending variables (Y_1 and Y_4) are not appreciably affected by the elimination of the state aid variable from the estimating procedure; in the partitioned model the estimated coefficients fall substantially when the state aid variable is removed. Moreover, the effect of partitioning the model is that the value of the coefficient for the total current spending variable (Y_1) is higher for the estimates where state aid is included (Row 5), but essentially unchanged in those estimates in which it has been excluded (Row 6); whereas the coefficient of the vocational spending variable (Y_4) is appreciably lower for both specifications of the partitioned model. These patterns of change are too confusing, given our present state of knowledge about interactions among the separate variables, to attempt to interpret in terms of _a priori_ notions. Their repetition in the results of estimates from other cross-sectional data suggests the existence of hidden underlying phenomena that our present model has not been able to capture.

Part 4 -- Empirical Results for Cities, 1962

As is usually the case with empirical research, some desirable areas of study cannot be pursued because of lack of salient numerical data. This proved to be true of our examination of the enrollment and educational spending interaction for the cross-section of seventy-nine urban areas in 1962. Data on current spending on vocational education, and on enrollment in these vocational programs, which would have permitted the development of a complete set of estimates from the full multi-equation system described in Part 2, are simply not available on a city-by-city basis. Thus, the regression estimates discussed in this section are not directly comparable with those elaborated in Part 3. Rather, we have provided estimates of the parameters of equations (1) and (4) of Part 2, wherein we set forth the *a priori* determinants of current spending on public elementary and secondary education and the enrollment rate in public education, and we have generated these estimates only within the framework of our partitioned model.[38]

Nevertheless, a comparison, although perforce imprecise, of the available estimates for cities with the similar estimates for the state-by-state cross-section should prove to be useful. It will, if nothing else, provide a check on the results for states. Moreover, these partitioned two-equation model estimates will give an indication of the requisite modifications for policies that might be applied on a city-wide level. Finally, the analysis of enrollment and educational spending interrelationships for urban core areas is of vital interest *per se*. The major purpose of Part 4 is to provide a forum for discussion and amplification of our regression results for the two-equation model for cities in 1962.

The Determinants of Current Educational Spending per Student -- Table 4-1 enumerates the 2SLS and OLS estimates of the impact of the several determinants of current educational spending per publicly enrolled student. For the 2SLS results (*Row 1*) six of the coefficients are larger than twice their standard errors, and therefore are judged to be significantly different from zero. In none of these six instances is the sign of the regression coefficient incompatible with our *a priori* expectations. In terms of absolute size, the largest coefficient (as well as the beta weight, which is not reported) is that for the endogenous variable, the public school enrollment rate per capita (Y_2). This coefficient indicates that, for urban areas, a ten percent greater enrollment rate is associated with a 7.4 percent

Table 4-1
The Determinants of Spending per Student (Y_1)*

	Y_2 = Log of publicly enrolled students per capita	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_5 = Log of population density (per sq. mile)	X_6 = Log of population	X_7 = Log of average annual salary of instructional staff	X_8 = Log of percent publicly enrolled students in high school	X_9 = Log of publicly enrolled students per operating school district	X_{10} = Log of the estimated market value of taxable property per capita	X_{11} = Log of percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of intergovernmental revenue received from the state government per capita	X_{13} = Log of intergovernmental revenue received from the federal government per capita	Constant	S.E. / R^2
Row 1 2SLS Partitioned	-.74 (.20)	.55 (.20)	-.04 (.07)	-.01 (.25)	-.04 (.02)	-.06 (.025)	-.01 (.02)	.49 (.13)	.16 (.19)	-.01 (.01)	-.01 (.08)	-.18 (.11)	.10 (.03)	.0001 (.01)	-.97 (1.29)	.0976
Row 2 OLS Partitioned	-.56 (.11)	.55 (.20)	-.02 (.07)	-.07 (.24)	-.05 (.02)	-.04 (.02)	-.02 (.02)	.53 (.12)	.22 (.18)	-.010 (.014)	.01 (.18)	-.16 (.11)	.09 (.03)	.0004 (.03)	-1.04 (1.27)	.0957 (.80)

* Regression coefficients of the several variables are given in the cells below. Standard errors of these regression coefficients are noted in the parentheses.

lower level of current educational spending per pupil. This inverse relationship, and its relatively large size, suggests that, for an area of given size, revenue constraints and general attitudes about education are substantial determinants of educational budgets. Confronted with higher enrollments, local educational systems permit the quality of education, as measured by per pupil outlays, to decline.

Our results also indicate the relevance of family income (X_1) in determining educational outlays. The estimated elasticity of spending per student with respect to family income, .55, lies within the range of values derived, for example, by Hirsch.[39] Interpretation of this finding is not without its ambiguities, however. For example, family income may be a measure of a community's affluence. But, since family income also reflects the general level of wages and salaries paid in an area, it might also be construed as a proxy for educational salary costs. To guard against this possibility, we included in our regression model a separate variable for teachers' salaries (X_7), in effect netting out the impact of salary cost differentials. So the parameter on the family income variable is in some sense a *ceteris paribus* income elasticity for educational services. Moreover, the relatively low current educational spending elasticity of the teachers' salary variable, .49, implies an adjustment of teaching load or effort to regional salary differentials. The figure implies that areas where teachers' salaries are relatively high find ways of economizing on educational resources that are not implemented in lower cost regions, perhaps by instituting higher student-teacher ratios.[40]

Interestingly, we find for these seventy-nine cities that racial composition, as measured by the percent of the population that is nonwhite (X_4), has a significant, but modest, negative impact on per pupil spending. Again, because this is a multiple regression analysis in which the effects of other pertinent variables, such as income levels and salary differences, have been netted out, there is an indication here of some educational disadvantage in areas of relatively large nonwhite populations. This is almost certainly a reflection of relative political strengths in 1962 and of the impact of tax payers' willingness to support public education in urban core areas. Given that the disadvantaged groups in our society stand to gain most from education, it is difficult to attribute this negative relationship of educational spending to racial mix to this component of educational demand -- a conclusion that is perhaps further supported by evidence of the impact of adult educational attainment on spending per student. In our estimates we observe that the level of education completed by adults in a specific area (X_3) has no statistically significant bearing on current per pupil outlays.

Since this factor in the demand for educational services apparently is inconsequential,[41] it does not seem unreasonable to attempt to explain the racial mix coefficient in terms other than educational demands by the nonwhite population.

One cannot ignore, however, the possibility that funding the public school system is only one, albeit the major one, of many demands made upon local governmental revenues. Our proxy for the budgetary pressures stemming from these alternative demands, amorphous though it might be, is an area's population density (X_5). Measured in this way, the competition of alternative demands on the public treasury seems to restrict expenditures on education, as is shown by the value of -.06 for the regression coefficient on population per square mile. This finding accords with previous ones indicating an apparent trade-off between spending on education and meeting public needs in urban areas.[42] It also suggests, as is partially confirmed by our model, that availability of funds from outside the local area -- either state or federally raised -- should have a stimulative effect on per student spending by alleviating the local tax revenue bottleneck.

Somewhat surprisingly, the population size of the city (X_6) is not significantly associated with differences in educational spending per student. Moreover, our earlier state-by-state finding of economies of scale, at least at the school district level (X_9), does not seem to extend to the city data. However, a conclusion that there are no scale effects in the educational process might be hasty. While we have not, in this study, examined the relationship between city size and relative factor price levels, it is entirely possible that the association is positive. If this is so, then the fact that our city cross-section reveals no appreciable scale factor may be due to the counteracting impact of higher educational factor prices in relatively large cities. There is, of course, in this line of argument no indication of why the two potential cost-affecting phenomena are roughly offsetting. But the possibility of sizeable scale economies to population size which is counterbalanced by relative factor price differentials related to city size is not inconsistent with the results reported in Table 4-1. The absence of economies of scale to school district size may be due to the fact that at the city level districts are relatively large compared to the average sized district at the state level. Economies of scale may be exhausted at relatively small district sizes, and hence do not show up in city data.

Total state aid per capita (X_{12}), it is gratifying to note, appears to have a mildly stimulative impact on current educational spending per student. The relatively low elasticity of response, .10, is in one sense an indication of the fungibility of governmental revenues at the local level. Thus, state-supplied educational funds do not augment total educational spending on a one-to-one basis, but rather may permit localities to divert substantial amounts of local revenues, that would otherwise have found their way into educational support, into non-educational programs. Again this generalization is not incompatible with our results. Moreover, it should be noted that our low spending elasticity to changes in state aid is not directly comparable with figures from other studies. Only about forty percent of total state aid is earmarked for education in urban areas, and less than twenty percent of the population is enrolled in public schools. Nevertheless, it seems that the share of total state aid devoted to public elementary and secondary education is negatively correlated with the level of such aid.[43]

That neither the taxable property variables (X_{10}, X_{11}) nor the student mix variable (X_8) have a significant impact on educational spending per pupil may be rationalized on statistical grounds. The former variables are based on relatively unreliable, or possibly questionable adjustments of, underlying data. Moreover, these variables are quite positively correlated with family income, one of the variables that was highly significant. The latter variable, on percent of total enrollment in high school, has very little variability over our city cross-sectional sample. But beyond these statistical limitations there are other possible reasons for the insignificance of these variables as determinants of educational spending per pupil. Urban centers, for example, have greater opportunity than other types of local government to exploit other tax sources when the property tax base is relatively small or fiscally insufficient. Urban areas, that is, are more insulated from factor mobility which has as its main incentive the reduction of tax burdens, levied on whatever base, than are other localities.[44] The absence of a student mix variable from among the significant determinants can be explained by the possibility that budgetary constraints are compelling -- indeed overriding -- so that cities with comparatively large high school populations compensate by lowering relatively over-all education quality in order to offset the higher educational costs that inhere in secondary school programs.

Comparison of City and State Cross-Sectional Educational Expenditure Results, 1962 -- In comparing the econometric estimates recorded in Table 3-1, Row 5, with those in Table 4-1, Row 1 -- the relevant comparison, since both show findings for 2SLS estimates from the partitioned model -- a number of differences come to the fore. Most importantly, we have seen that total spending per pupil on education does vary positively, across cities, with the enrollment rate, although less than proportionately. Across states, however, higher enrollment rates are not at all associated with a change in current educational outlays; in fact, those states with higher enrollment rates may even exhibit slightly lower educational budgets.[45]

A second difference is that for cities, educational spending per student appears to be responsive to income per capita, our measure of affluence, while this is not true for states. Since the coefficients of variation for the independent variables are similar for the two samples, this result is not a statistical curiosity stemming from differences in the variation of the independent variable. For both sets of results, the two variables, fraction of those with income below $3,000 and educational attainment of adults, have little impact on spending. For cities both percent nonwhite and population density have a sizable negative impact on spending per student, while population size has no impact. For states none of these variables has a significant apparent effect on educational expenditures per pupil. Thus, there are apparent discrepancies in the econometric determinants of per student current educational outlays at the state level, on the one hand, and for urban areas on the other.

In contrast, for both cross-sections teachers' salaries have a large positive impact on spending per pupil. However, since the impact is larger for states than for cities, a lower degree of substitutability of other educational resources for teachers is indicated at the state level. In addition, the results imply a greater degree of deterioration in educational quality for cities where teachers' salaries are higher, relative to lower salaried cities, than for states with higher teachers' salaries, compared to states with lower salary levels.

Greater relative high school enrollments lead to a barely perceptible increase in spending for both city and state results. Larger school districts exhibit lower levels of spending per student, which presumably in turn is related to lower costs. Note, however, that the impact of this variable is more important across states than across cities. One reason why economies of scale might be less appreciable for cities, as already mentioned, is that average school district size within cities is roughly ten times that of states. Conceivably, most districts within cities are probably at or beyond the minimum critical size needed to realize economies of scale, while this is not true of the average school district within a state.

The value of taxable property per capita has a positive perceptible impact on educational spending per student in the state cross-section, but not across cities; whereas the percent residential property variable is more important for cities than for states. Concerning the state aid variable, we see that its coefficient is positive and about three times its standard error for cities, but that this regression coefficient is close to zero for the sample of states. It should be noted, in extenuation, that the state aid variable for the city sample measures total aid for all purposes, while the equivalent variable for states includes only aid for educational purposes. Thus, the estimated coefficients are not directly comparable, and their relative values would depend on how aid for other than educational activities varies with aid to education on a city-by-city basis. Finally, for both cross-sections federal aid apparently has no appreciable impact on educational spending per student.

The Determinants of Enrollments per Capita -- Table 4-2 records our 2SLS and OLS estimates of equation (4) of Part 2, which gives the a priori determinants of the enrollment rate. From Row 1 we can see that three of the regression coefficients are greater than twice their standard errors -- those on the level of current educational spending per publicly enrolled student (Y_1), the percentage of the population that is Catholic (X_{14}), and the percentage of population that is of school age (X_{16}). Contrary to our theoretical expectations in formulating the elements of equation (4), the regression coefficient of only one other variable exceeded its standard error -- our proxy for income distribution (X_2) -- and in its case the ratio was just short of 1.4.

The most interesting result of these estimates of the enrollment equation from the 1962 city cross-section centers around the enrollment elasticity with respect to educational spending. This elasticity of .48 indicates that public school enrollment is relatively sensitive to the quality of a given public school system, as manifested in its per pupil spending level. For each ten percent increase in educational outlays per student, the enrollment per capita will, on the average, rise by nearly five percent. An explanation for this sensitivity is perhaps, for one thing, that relatively fewer children in areas of higher educational quality go to private schools or that relatively fewer drop out of the school system. In addition, this positive elasticity is consistent with the view that the higher is spending per student in a particular city, the more likely it is that families with school aged children will assume residence in that city. Not only is it likely that firms find it relatively attractive to locate their operations in urban areas with better educational quality, but given that this is the case families in which the breadwinner is employed by these firms are more apt to live relatively close to the work

Table 4-2
The Determinants of Public School Student Enrollments per Capita (Y_2)*

	Y_1 = Log of current spending on education per publicly enrolled student	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_6 = Log of population	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	Constant	S.E. / $\bar{R}^2$
Row 1 Partitioned 2SLS	.48 (.19)	.16 (.27)	.11 (.08)	.20 (.25)	.02 (.02)	-.01 (.02)	-.14 (.22)	-.09 (.03)	-.02 (.02)	1.65 (.33)	-4.67 (1.45)	.113
Row 2 Partitioned OLS	.04 (.09)	.46 (.21)	.07 (.06)	.14 (.20)	-.01 (.02)	.004 (.02)	-.02 (.18)	-.04 (.02)	-.03 (.02)	1.32 (.27)	-3.94 (1.18)	.096 (.73)

* Standard errors of the regression coefficients are given in parentheses.

location. Not all of the SMSA's in our sample of cities are so large that escape to the suburbs (i.e., outside of the SMSA) is impossible or even inconvenient. The findings suggest that escape for purposes of educational betterment is less likely, quite naturally, where high per pupil educational spending prevails.

As noted before, we have attempted to determine the net impact of the fact that Catholic and Jewish parochial schools constitute sizeable fractions of available educational facilities in some areas, and also that these two religions, more so than others for which separate statistics are available, have relatively higher pressures for attendance in church-supported schools. Given, however, that Catholics, as a hypothesis, are relatively more widely dispersed among our sample cities than are Jews, and that the former are a substantial proportion of most cities' populations, we would expect that our results are more apt to discern for Catholics than for Jews a net impact on the public school enrollment rate. To test these two hypotheses the percents of each city's population that is Catholic (X_{14}) and Jewish (X_{15}) were inserted into the enrollment equation. These variables, it should be cautioned, allow for both a greater supply of, and a greater demand for, parochial school education in urban areas with large concentrations of these two religious groups. That we find, in Table 4-2, a significant negative impact of the presence of a high percentage of Catholics in a city on the enrollment rate in the public school system -- together with a statistically insignificant negative effect for the percent that is Jewish -- is consistent with our expectations.

Surprisingly, the coefficient of the variable measuring the percent of the population that is of school age (X_{16}) is somewhat greater than we had anticipated. A regression coefficient of 1.65 indicates that, _ceteris paribus_, a ten percent difference in the number of school aged children will lead to a sixteen and one-half percent difference in the enrollment rate in the public schools. Why there should be this magnification on the enrollment rate is an issue to which there seems to be no rational answer. Given that the regression coefficients yield _net_ impacts, it cannot be explained by other variables that have been included in the enrollment equation for purposes of estimation. On the other hand, in setting up our model of the determination of the enrollment rate we have consciously attempted to be all-inclusive. Thus, this result for the 1962 city cross-section remains an enigma, although we conjecture about its cause when we compare below this result with the equivalent finding for the state sample.

There are other variables which on _a priori_ grounds we thought would be recognizeable determinants of the enrollment rate. In the event, however, this expectation was unfulfilled. The percent of the city's population that is nonwhite (X_4) and the percent that is enrolled in high schools (X_8) did not significantly affect the enrollment rate. Moreover, it should again be acknowledged that our findings relate to the decision to enroll in the public school system, rather than to the more general decision to enroll in school per se. We have seen elsewhere that differences in income levels (X_1) and in parental education attainments (X_3) may lead to offsetting effects on the public school enrollment rate. Thus, it is really not too surprising that we find the regression coefficients on these variables to be less than their standard errors. Of course, we should not interpret this result as signifying that the decision to enroll in any elementary or secondary school is not influenced by parental income or education. There is, we know, ample evidence to the contrary.[46]

Comparison with State Cross-Section Results for 1962 -- With little exception, the results for the enrollment equation for cities using 1962 data are similar to those for the enrollment equation for states in the same year. Both reveal, as anticipated, a positive response of public school enrollment rates to current educational outlays per student, with the city results exhibiting a somewhat higher expenditures elasticity (.48 compared to .33). The higher elasticity for cities may reflect a greater availability of private education in urban areas due to economies of scale in operation. Catholics, who are the principal consumers of private education, are concentrated in urban areas. For example, the mean percent of Catholics in our city sample was 23.6, whereas the mean for the state cross-section was 18.0 percent. For both the state and the city regressions, the percent Catholic variable has a negative coefficient which exceeds (in absolute value) twice its standard error. The size of this coefficient is somewhat greater for the city sample, indicating perhaps a greater opportunity for Catholics within cities to attend parochial schools. In contrast, for the statewide sample the percent of the population that is Jewish had a significant negative impact on public school enrollment rates, although this was not the case for the sample of cities. This latter differential result, one can speculate, is less attributable to economies of scale in the operation of private schools than to disparate educational taste among some groups of the population.

For the state cross-section results, a greater percentage of high school students was associated with a lesser enrollment rate and this was also true for the sample of cities. In the latter instance, however, the absolute value of the estimated regression coefficient was less than the standard error of the estimate. These findings are understandable in light of the overwhelming evidence on the age incidence of the drop-out phenomenon, which rarely occurs among elementary school students. Therefore, it is not unreasonable to find that a higher percentage of high school students is associated with fewer public school enrollments per capita.

The most notable difference in the two sets of regression results so far reported occurs in the estimate of the coefficient of the school aged children per capita variable. Although both estimates yield positive coefficients, for the city cross-section the estimated value exceeds unity, while for the state-by-state results the coefficient is well below unity. This difference is of substantial import since it indicates a positive response of enrollment per school aged child to children per capita for the city sample, but a negative response for the state cross-section.[47] One possible explanation of this difference, not without policy implications, is a systematic tendency for the number of school aged children to be related to the relative size of the agricultural sector by state.[48] School aged children are more productive in an agricultural setting. In addition, more children per family intensify pressures to drop out of school early. These pressures are most effective where good alternative employment is available -- opportunities requiring neither a high level of skills or a mature sense of judgment. Farms, more than commercial or manufacturing activities, seem to be relatively well suited for employment of the drop-out. As these jobs are not readily available within urban areas, the percentage drop-out rate should be relatively low, other things being equal. Thus, relatively large numbers of children in the population may merely preclude, on any significant scale, the possibility of attendance at private schools within cities. The consequence of these forces, then, is an increase in the public school enrollment rate in cities compared to what is found in the state-by-state sample.

Part 5 -- Empirical Results for States, 1957 and 1952

The Determinants of Current Spending per Student -- The estimates of our spending equation, based upon the state cross-sectional sample, for 1957 and 1952 are given in Tables 5-1a and 5-1b respectively. The format of these tables differs from that of preceding tables in that the results for the model in which we have excluded the state aid to education variable are not present. Thus, each table contains parameter estimates for just four equations. In addition, for the 1957 sample all variables which have been taken from the Census of Population were collected in 1959. Since this type of variable is usually slow to change, the 1959 cross-sectional rankings should prove to be adequate proxies for 1957 values.

In Table 5-1a, Row 1, the 2SLS results for the full four equation model are recorded. The estimated coefficient of the enrollment rate variable (Y_2) is negative and less than one in absolute value, signifying that total spending on education varies directly with the enrollment rate, but the variation is less than proportionate. The comparable 2SLS coefficient estimated from 1952 data, as presented in Table 5-1b, Row 1, leads to the same general conclusion. However, the absolute value of the estimated coefficient for 1952 is appreciably higher, indicating less variation in current educational spending as the enrollment rate changes. It is also of interest to note that these two estimates -- for 1957 and 1952 -- yield coefficients for the enrollment rate variable which bracket that derived from 1962 data. The estimated 1962 enrollment rate coefficient falls roughly half-way between the 1957 and 1952 estimates.

For both 1957 and 1952 the OLS estimates of the regression coefficients of the enrollment rate variable (Tables 5-1a and b, Row 2) are slightly below the comparable 2SLS estimates just cited. Thus, in these years when the assumed simultaneous feedbacks in the determination of public school enrollment rates and current spending per student are disregarded we do not get appreciably different estimates of the net relationship between these two variables. It will be remembered, in contrast, that the coefficients of the endogenous variables in the 1962 state cross-sectional estimates differed markedly between the OLS estimate and the 2SLS estimate, with the latter being significantly larger in absolute terms.

Since our parameters depict percentage change relationships, i.e., elasticities of response, this means that

Table 5-1a
Determinants of Current Spending per Student, 1957 (Y_1)*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_5 = Log of population density (per sq. mile)	X_6 = Log of population	X_7 = Log of average annual salary of instructional staff	X_8 = Log of percent publicly enrolled students in high school	X_9 = Log of publicly enrolled students per operating school district	X_{10} = Log of the estimated market value of taxable property per capita	X_{11} = Log of percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of intergovernmental revenue received from the state government for education per capita	X_{13} = Log of intergovernmental revenue received from the federal government for education per capita	Constant	S.E. / R^2
Row 1 4 Equation 2SLS	-.47 (.28)	-.06 (.05)	.21 (.21)	-.01 (.12)	.26 (.34)	-.035 (.025)	-.003 (.03)	.01 (.02)	.56 (.24)	.08 (.11)	-.06 (.02)	.12 (.09)	.01 (.24)	.07 (.05)	-.01 (.05)	-2.05 (2.10)	.0884
Row 2 OLS	-.45 (.22)	-.04 (.04)	.23 (.20)	-.03 (.11)	-.32 (.33)	-.037 (.024)	-.003 (.03)	.01 (.02)	.57 (.23)	.06 (.10)	-.06 (.02)	.12 (.08)	.04 (.24)	.07 (.04)	-.01 (.05)	-2.02 (2.05)	.0878 .876
Row 3 Partitioned 2SLS	-.88 (.40)	-- --	.14 (.23)	.09 (.13)	-.49 (.34)	-.053 (.026)	-.004 (.03)	.02 (.03)	.36 (.28)	.04 (.11)	-.06 (.02)	.19 (.11)	.15 (.25)	.11 (.06)	.001 (.06)	.98 (2.27)	
Row 4 Partitioned 2SLS	-.44 (.22)	-- --	.26 (.20)	-.05 (.11)	-.40 (.31)	-.04 (.02)	-.002 (.03)	-.006 (.02)	.57 (.23)	.05 (.10)	-.06 (.02)	.11 (.08)	.07 (.23)	.06 (.04)	-.01 (.05)	-1.94 (2.04)	.0876 .877

* Standard errors of the regression coefficients are given in parentheses.

Table 5-1b
Determinants of Current Spending per Student, 1952 (Y_1)*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_5 = Log of population density (per sq. mile)	X_6 = Log of population	X_7 = Log of average annual salary of instructional staff	X_8 = Log of percent publicly enrolled students in high school	X_9 = Log of publicly enrolled students per operating school district	X_{10} = Log of the estimated market value of taxable property per capita	X_{11} = Log of percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of intergovernmental revenue received from the state government for education per capita	X_{13} = Log of intergovernmental revenue received from the federal government for education per capita	Constant	S.E. / R^2
Row 1 4 Equation 2SLS	-.87 (.22)	.03 (.04)	-.02 (.21)	-.13 (.13)	-.52 (.26)	-.04 (.02)	-.02 (.03)	-.01 (.02)	.65 (.15)	.16 (.17)	-.04 (.02)	.118 (.064)	.11 (.14)	.07 (.03)	.040 (.036)	-1.24 (2.02)	.0874
Row 2 OLS	-.75 (.18)	-.004 (.03)	.03 (.20)	-.08 (.12)	-.49 (.25)	-.04 (.02)	-.01 (.03)	-.004 (.02)	.68 (.15)	.17 (.16)	-.04 (.017)	.12 (.06)	.09 (.14)	.068 (.027)	.045 (.035)	-1.97 (1.92)	.0854 .907
Row 3 Partitioned 2SLS	-.77 (.24)	-- --	.02 (.20)	-.09 (.11)	-.49 (.24)	-.04 (.02)	-.01 (.03)	-.004 (.02)	.68 (.14)	.17 (.16)	-.043 (.017)	.12 (.06)	.09 (.13)	.07 (.03)	.04 (.03)	-1.88 (1.84)	.0841
Row 4 Partitioned OLS	-.75 (.18)	-- --	.03 (.19)	-.09 (.11)	-.49 (.23)	-.04 (.02)	-.01 (.03)	-.004 (.02)	.68 (.14)	.17 (.16)	-.043 (.017)	.12 (.06)	.09 (.13)	.07 (.03)	.04 (.03)	-1.91 (1.82)	.0841 .909

* Standard errors of the regression coefficients are given in parentheses.

total spending changed less in 1962 in response to changing enrollment than it did in either 1957 or 1952, when compared to estimates in which the enrollment rate-per pupil spending interaction is ignored. It is difficult, perhaps impossible, to ascertain the basis of this difference in the relationship between per pupil spending, on the one hand, and the enrollment rate, on the other. Possibly the most appropriate speculation is that educational administrators have become increasingly aware of and sensitive to the "mobility" of the student population. As between the 1950's and 1962, they were beginning to respond to a fiscal pinch by designing school programs which could accommodate the same enrollment variations with relatively lower adjustments in current educational expenditures. In the vernacular of economics, adaptability was being built into the educational programs of school districts. But this is only one conjecture; other hypotheses may be more consistent with the findings for 1962 as compared with those for 1957 and 1952.

The 2SLS parameters for the enrollment rate in the partitioned model (Row 3 of the two tables) differ from those of the full four equation model estimates. From the 1957 sample the partitioned model yields a regression coefficient that is substantially higher than the equivalent parameter of Row 1, whereas the coefficient of the enrollment rate in the partitioned model is slightly below the comparable four equation estimate based on 1952 data. Since in most cases the estimated coefficient of the enrollment variable exceeds twice its standard error, although it is only 1.66 times its standard error for the 2SLS estimate of the four equation model for 1957, the figures have reasonable credibility. All estimates of this coefficient lead to the conclusion, not unlikely on the surface of it, that total spending on education varies with enrollments, but less than proportionately.[49]

For all estimates, we find again that vocational enrollments (Y_5) have little perceptible impact on spending per student, and that vocational spending has a negligible impact on total enrollments. As before, these results suggest that we place somewhat more emphasis on the partitioned variant of the model. For this version, the estimated coefficient of the percent nonwhite variable (X_4) is approximately twice its standard error for both the 1957 and 1952 samples. The estimate itself indicates that a twenty-five percent positive increment to the nonwhite population of a state would be associated with a one percent decrement to per student educational outlays. The estimated coefficient is somewhat greater for the 1952 and 1957 samples, perhaps indicating some increase in the relative quality of schools primarily for nonwhites by 1962.

The estimated coefficient of the teachers' salaries variable (X_7) is again positive and less than unity. It is notable, however, that both the 1957 and 1952 estimates are below the commensurate coefficient for the 1962 state cross-section. One explanation of this is that in the earlier years there was a greater adjustment of teacher-student ratios to salary differentials than had taken place in 1962. This hypothesis is consistent with the increasing unionization and militancy among teachers and their growing concern over working conditions. It would be interesting to see whether, in subsequent years, the regression coefficient is still larger, since undoubtedly unionization and bargaining power of non-union teachers' organizations has been surging upward since 1962.

The state-by-state data for 1957 and 1952 again yield an indication of lower per pupil educational expenditures in school districts of larger size. The value of the coefficient on district size (X_9) is of the same order of magnitude in the 1952 and 1962 estimates, but it has a somewhat greater absolute size in the 1957 estimates. These similarities in the size of the regression coefficient apparently demonstrate that there has been no appreciable decrease in the rate of returns to scale, despite an expansion in average enrollment per school district of over fifty percent between 1952 and 1962. However, it must be cautioned that our estimates do not give evidence on the particular causes of the decreasing educational costs per student in larger district units. These may be based on administrative or educational economies, or both. On whether the sources are intra-district or intra-school, or both, in character we shed no light.

The state aid variable (X_{12}) exhibits a larger coefficient in the earlier years when state cross-sectional data are exploited. For the 1957 sample, the coefficient estimate usually exceeds 1.5 times its standard error. For the 1952 sample, the statistical performance of this aspect of the model is appreciably better, with the coefficient estimate exceeding twice its standard error in all four cases. The decline in the relative magnitude of the state aid to education variable over time does not reflect a relative change in the importance of state aid as a source of funds.[50] Rather, there just appears to be an increased tendency to use state educational aid as a substitute for -- not as a supplement to -- locally generated school funds.

<u>The Determinants of Enrollment per Capita</u> -- An examination of the estimates of the enrollment equation from 1957 and 1952 state cross-sectional data reveals a major change in the estimated elasticity of enrollment with respect to spending. For both sets of estimates, which are given in Tables 5-2a and 5-2b, the coefficient of the spending per

Table 5-2a

Determinants of Public School Student Enrollment per Capita, 1957 (Y_2)*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_6 = Log of population	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	Constant	S.E. / $\bar{R}^2$
Row 1 4 Equation 2SLS	.01 (.12)	-.02 (.05)	-.13 (.16)	.01 (.08)	.07 (.19)	.001 (.01)	.015 (.015)	.05 (.08)	-.04 (.02)	-.05 (.02)	.14 (.12)	-1.80 (1.39)	.0720
Row 2 OLS	-.04 (.11)	-.04 (.04)	-.09 (.16)	.02 (.08)	.09 (.19)	.002 (.01)	.01 (.01)	.05 (.08)	-.04 (.02)	-.05 (.02)	.15 (.12)	-1.98 (1.37)	.0716 (.748)
Row 3 Partitioned 2SLS	.03 (.15)	-- --	-.15 (.18)	.0003 (.08)	.06 (.20)	.007 (.01)	.017 (.014)	.04 (.08)	-.04 (.02)	-.053 (.015)	.14 (.12)	-1.65 (1.35)	.0718
Row 4 Partitioned 2SLS	-.03 (.11)	-- --	-.10 (.16)	.003 (.08)	.08 (.19)	.001 (.01)	.017 (.014)	.05 (.08)	-.033 (.017)	-.054 (.015)	.14 (.12)	-1.73 (1.34)	.0715 (.748)

* Standard errors of the regression coefficient are shown in parentheses.

Table 5-2b

Determinants of Public School Enrollments per Capita, 1952 (Y_2)*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_6 = Log of population	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	Constant	S.E. / $\bar{R}^2$
Row 1 4 Equation 2SLS	.0008 (.09)	-.03 (.04)	-.005 (.16)	.01 (.08)	.63 (.14)	.02 (.01)	-.004 (.01)	-.19 (.13)	-.04 (.02)	-.024 (.013)	.86 (.21)	-5.30 (1.80)	.0629
Row 2 OLS	-.04 (.08)	-.03 (.04)	.03 (.15)	.005 (.08)	.62 (.14)	.02 (.01)	-.004 (.01)	-.16 (.13)	-.032 (.015)	-.024 (.013)	.88 (.21)	-5.41 (1.80)	.0627 (.860)
Row 3 Partitioned 2SLS	.16 (.12)	-- --	-.12 (.17)	.02 (.08)	.68 (.15)	.021 (.012)	-.003 (.014)	-.28 (.14)	-.043 (.016)	-.024 (.013)	.79 (.22)	-4.83 (1.92)	.0666
Row 4 Partitioned 2SLS	-.03 (.08)	-- --	.03 (.15)	-.001 (.08)	.61 (.14)	.02 (.01)	-.001 (.01)	-.18 (.12)	-.030 (.014)	-.027 (.013)	.87 (.20)	-5.33 (1.78)	.0623 (.862)

* Standard errors of the regression coefficients are shown in parentheses.

student variable (Y_1) is quite small and, with a single exception, is less (in absolute value) than its standard error. There is clearly a strong temptation to attribute this change to the heightened awareness of the role of education in the era following the launching of "Sputnik." However, we see below that the comparable coefficient derived from estimates using the city cross-section was actually slightly higher for 1957 than for 1952. A more likely explanation is that which we supplied in rationalizing the smaller coefficient for the expenditure variable that we obtained from 1962 data when estimated from the state cross-section rather than from the city cross-section. It was hypothesized that returns to scale in school size made the minimum school size more easily attainable in urban areas. Therefore, private schooling was more readily available in urban core areas. Following this line of reasoning, we would expect an urban-suburban out-migration to have enabled more suburban fringe areas to support a private school of at least the minimum size needed to achieve efficient operation. Thus, over time, with greater availability of private schools throughout a given state, public school enrollment rates could conceivably become more responsive to school quality differences.

As for the other variables that a priori help to determine the public school enrollment rate, we again find the religious mix of a state and the number of children of school age in the state to be the most important determinants. As before, states with a greater concentration of Catholics (X_{14}) and of Jews (X_{15}) demonstrate a lower public school enrollment rate. States with a higher concentration of school aged children (X_{16}) exhibit more public school enrollments per capita. It should be noticed, however, that the regression coefficient for the school aged children variable is much larger for the 1952 cross-section.[51] In fact, that is the only sample for which the estimated coefficient exceeded twice its standard error. One possible explanation is associated with the downward trend in average family size in the postwar period. With fewer children per family in 1962, more relatively large families were able to send their children to private educational institutions if they wished, causing less systematic variation in private versus public enrollment from this source, and thereby leading to a lower estimated impact of the school aged population ratio on public school enrollment rates in 1957 and 1962 than in 1952.

The Determinants of Spending on Vocational Education -- The estimates of the vocational spending equation derived from state cross-sectional data for 1957 and 1952 are given, respectively, in Tables 5-3a and 5-3b. In this set of estimates we see that the fraction of educational expenditures that is devoted to vocational programs varies very

Table 5-3a
Determinants of Percent Spending on
Vocational Education, 1957 (Y_4)*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	Y_{27} = Log of federal spending on vocational education as a percent of federal spending on education	Y_{28} = Log of state spending on vocational education as a percent of state spending on education	Constant	S.E. / $\bar{R}^2$
Row 1 4 Equation 2SLS	1.17 (.28)	.40 (.10)	.14 (.07)	.16 (.04)	-1.24 (.43)	.2249
Row 2 OLS	1.02 (.25)	.42 (.08)	.14 (.07)	.16 (.04)	-1.43 (.42)	.2240 .697
Row 3 Partitioned 2SLS	1.02 (.27)	.42 (.10)	.14 (.07)	.16 (.04)	-1.43 (.42)	.2240
Row 4 OLS		SAME AS ROW 2				

* Standard errors of the regression coefficients are given in parentheses.

Table 5-3b
Determinants of Percent Spending on Vocational Education, 1952 (Y_4)*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	Y_{27} = Log of federal spending on vocational education as a percent of federal spending on education	Y_{28} = Log of state spending on vocational education as a percent of state spending on education	Constant	S.E. / $\bar{R}^2$
Row 1 4 Equation 2SLS	.91 (.25)	.34 (.10)	.08 (.07)	.11 (.04)	-1.55 (.37)	.2446
Row 2 OLS	.82 (.24)	.39 (.08)	.08 (.07)	.10 (.14)	-1.58 (.37)	.2434 .538
Row 3 Partitioned 2SLS	.86 (.25)	.35 (.11)	.07 (.07)	.10 (.04)	-1.60 (.37)	.2442
Row 4 OLS		SAME AS ROW 2				

* Standard errors of the regression coefficients are given in parentheses.

approximately in proportion to changes in the enrollment rate in public schools (Y_2). This conclusion is based on the estimated regression coefficients in the first column of the tables. There is a slightly greater than proportionate response indicated for 1957 but an appreciably less than proportionate response for 1952. Moreover, a glance at Table 3-3 (p. 3-12), especially Rows 1 and 5, which are comparable to the vocational spending estimates being discussed here, shows that the response of the vocational spending ratio to changes in the over-all enrollment rate has been increasing over time.

Similarly, the impact of the fraction of total public school students that is enrolled in vocational programs on the vocational spending ratio seems also to have been progressively stronger as we move forward in time from 1952 through 1957 to 1962. Although the estimated coefficient of the vocational enrollment-over-all enrollment ratio continually exceeds three times its standard error, for the full model the coefficient for 1952 is just about two-thirds of the comparable estimate for 1962 (Row 1 figures). With higher enrollment rates through time, parents qua voters may have become more responsive to the various elements of student demands for a broadened curriculum offering. This could explain the increased size over time of the coefficients for both the over-all public school enrollment rate (Y_2) and the ratio of vocational enrollment to total school enrollment (Y_5).

As for the effect of federal aid to education on the vocational spending ratio, it is apparent that the fraction of federal funds that went to support vocational education (Y_{27}) was of much less importance in determining relative vocational expenditures for the 1952 cross-section of states than it was in the 1962 sample. The relevant coefficients (Row 1 figures again) are .08 in 1952 and .32 in 1962, and the 1957 sample yields a value of .14. This behavior over time, we note, has occurred despite a decline in the fraction of federal educational aid which is allocated to vocational programs.[52] This trend -- if indeed it is a trend -- may reflect a declining tendency to substitute aid for local expenditures on vocational education over time. In turn, this tendency to substitute less for federal aid to vocational programs might be expected given the more than fifteen percent reduction in the fraction of educational spending which was devoted to vocational education outlays over the ten year period 1952 through 1962. For given a relatively smaller local base to begin with, substituting for local funds is naturally more difficult.

In contrast, however, the effect of changes in the state vocational spending ratio (Y_{28}) on the vocational spending percentage at the local level has varied little over time. The coefficient for 1957 (.16) is higher than for 1952 or 1962 (.11 and .10 respectively), but obviously no trend in this relationship is apparent. Why a systematic change in substitution between federal aid and local vocational spending exists whereas this is not found relative to state aid to vocational education is probably to be explained in adjustments over time in the matching or tie-in provisions attached to the acceptance of vocational aid originating from the federal government. It would take us too far afield to examine this possibility, but if federal vocational aid provisions have entailed progressively more stringent matching conditions, while state aid has had no change in attached strings, we would find support for our hypothesis.

<u>The Determinants of Relative Enrollment in Vocational Education Programs</u> -- With the possible exception of our estimates of the determinants of current educational spending per student from the 1957 and 1952 state cross-sections, it has made little difference, in the values of the parameters, whether the full four equation model or the partitioned model was utilized. That is no longer true when we estimate the determinants of the ratio of enrollments in vocational education programs. These estimates are shown in Tables 5-4a and 5-4b. The disparity in the estimates from the full four equation model and those from the partitioned model are seen clearly in the elasticities of the fraction of enrollment in vocational education programs with respect to total spending per student and with respect to the fraction of total spending which goes to vocational programs. The elasticities are considerably lower for the partitioned version of the model, with the difference being especially striking for the estimates based on 1952 data.

While the fit of the "first stage" estimates might provide a partial explanation of this disparity, the differences in the first stage $\bar{R}^2$s do not seem to be great enough to provide a complete explanation.[53] Moreover, the differences in the first stage $\bar{R}^2$s were approximately the same for 1962 as for the earlier years, yet the disparity in the 1962 estimates between the four equation and the partitioned versions of the model were not so large.[54] While there is no clear criterion for picking between the two models, the possibility must be recognized that vocational enrollment was much less responsive both to spending on vocational education and to over-all spending per student in 1952 than in later years. If this possibility is indeed the case, this result would be consistent with our finding, discussed previously, that the over-all public school enrollment rate was less sensitive to spending differences on the state level in the early years.

The remainder of the variables that appear to be salient determinants of the vocational education enrollment ratio conform fairly closely, in terms of the direction and size of impact, to those already examined in Part 3 and discussed following the presentation of Table 3-4. It is perhaps not worthwhile here to repeat that discussion. Nevertheless, the regression coefficients for percent of workers classified as white-collar (X_{17}), skilled (X_{18}), and unskilled (X_{19}) are worth pausing over. In all three years for which we have made estimates, vocational enrollments seem to be influenced in about the same way by the occupational mix in a state. More white-collar and unskilled jobs lead to a lower vocational enrollment ratio, whereas the presence of more skilled jobs leads a larger percentage of total enrollments to fall within the vocational education programs. The consistency with which we observe these relationships, which of course conform to our a priori notions, is gratifying and lends credence to the validity of the structure of our simultaneous equations educational spending-enrollment model.

Table 5-4a
Determinants of Vocational Enrollment as a Percent of all Publicly Enrolled Students, 1957 (Y_5)*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_6 = Log of population	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	X_{17} = Log of percent of all workers classified as white collar	X_{18} = Log of percent of all workers classified as skilled	X_{19} = Log of percent of all workers classified as unskilled	X_{20} = Log of percent of all workers classified as service workers	X_{21} = Log of current expenditures on higher education per capita	X_{22} = Log of retail trade employees as a percent of total nonagricultural employment	X_{23} = Log of wholesale trade employees as a percent of total nonagricultural employment	X_{24} = Log of selected services employees as a percent of total nonagricultural employment	X_{25} = Log of manufactures employees as a percent of total nonagricultural employment	X_{26} = Log of the insured unemployment rate	Constant	$\frac{S.E.}{R^2}$
Row 1 4 Equation 3SLS	1.53 (.73)	.69 (.24)	-1.74 (.92)	.21 (.41)	1.42 (1.11)	.08 (.08)	-.03 (.08)	.60 (.35)	-.16 (.08)	.11 (.07)	.18 (.53)	-2.26 (1.14)	1.81 (1.01)	-.82 (.67)	-.05 (.78)	.30 (.25)	-.55 (.54)	.87 (.33)	.59 (.42)	.29 (.25)	-.20 (.16)	2.73 (8.15)	.2714
Row 2 4 Equation OLS	1.14 (.57)	.64 (.39)	-1.40 (.82)	.19 (.41)	1.39 (1.09)	.07 (.07)	-.02 (.08)	.59 (.35)	-.15 (.077)	.10 (.07)	.12 (.52)	-2.11 (1.12)	1.64 (.99)	-.78 (.66)	.19 (.69)	.33 (.24)	-.51 (.83)	.86 (.32)	.46 (.38)	.25 (.24)	-.17 (.15)	1.79 (7.97)	.2690 .637
Row 3 Partitioned 3SLS	.95 (.61)	.33 (.28)	-1.21 (.89)	.27 (.44)	1.11 (1.17)	.05 (.08)	-.02 (.08)	.60 (.37)	-.187 (.085)	.10 (.08)	.12 (.55)	-2.22 (1.19)	1.82 (1.05)	-1.00 (.72)	.63 (.79)	.36 (.26)	-.45 (.88)	.78 (.35)	.33 (.42)	.27 (.26)	-.17 (.16)	.37 (8.50)	.2853
Row 4 Partitioned OLS			SAME AS ROW 2																				

* Standard errors are given in parentheses.

Table 5-4b

Determinants of Vocational Enrollments as a Percent of all Publicly Enrolled Students, 1952 (Y_5)*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_6 = Log of population	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	X_{17} = Log of percent of all workers classified as white collar	X_{18} = Log of percent of all workers classified as skilled	X_{19} = Log of percent of all workers classified as unskilled	X_{20} = Log of percent of all workers classified as service workers	X_{21} = Log of current expenditures on higher education per capita	X_{22} = Log of retail trade employees as a percent of total nonagricultural employment	X_{23} = Log of wholesale trade employees as a percent of total nonagricultural employment	X_{24} = Log of selected services employees as a percent of total nonagricultural employment	X_{25} = Log of manufactures employees as a percent of total nonagricultural employment	X_{26} = Log of the insured unemployment rate	Constant	S.E. R^2
Row 1 4 Equation 2SLS	1.07 (.66)	.51 (.31)	.33 (1.07)	.81 (.47)	2.37 (1.09)	-.05 (.07)	.16 (.08)	-.77 (.82)	-.16 (.09)	.17 (.09)	.59 (1.26)	-3.24 (1.23)	1.70 (1.05)	-.94 (.53)	.37 (.79)	.39 (.29)	.13 (.17)	.24 (.40)	.05 (.45)	.05 (.11)	-.07 (.14)	-10.75 (11.69)	.3063
Row 2 4 Equation OLS	1.01 (.52)	.95 (.22)	.77 (.94)	.75 (.43)	1.98 (.98)	-.06 (.07)	.17 (.07)	-1.17 (.72)	-.09 (.07)	.11 (.08)	.44 (1.15)	-3.30 (1.13)	1.76 (.95)	-.69 (.47)	-.20 (.67)	.53 (.26)	.04 (.15)	.53 (.35)	.33 (.38)	.04 (.10)	-.05 (.13)	-9.90 (10.66)	.2815 .625
Row 3 Partitioned 2SLS	.05 (1.00)	-.12 (.83)	.76 (1.29)	.72 (.59)	2.31 (1.37)	-.05 (.09)	.18 (.10)	.25 (1.43)	-.18 (.12)	.22 (.14)	1.33 (1.70)	-2.86 (1.58)	1.20 (1.37)	-1.25 (.77)	1.53 (1.56)	.32 (.39)	.29 (.27)	-.10 (.66)	-.56 (.83)	-.0003 (.14)	-.05 (.17)	-16.21 (15.35)	.3873
Row 4 Partitioned OLS			SAME AS ROW 2																				

* Standard errors are given in parentheses.

Part 6 -- Results for Cities in 1957

Recall, as noted in Part 4, that we were unable to collect usable data on vocational program spending and enrollment rates in these programs for our city cross-section. Because of this, the model estimates which we report on here, while still based on a simultaneously determined educational spending-over-all enrollment rate relationship, has a more restricted chain of feedbacks than the model, estimates of which are employed on the state cross-sectional samples. For cities in 1957, as in Part 4, the model consists of a two, rather than four, equation system. The determinants of the spending ratio on vocational education and the enrollment ratio in these programs, therefore, could not be examined for want of appropriate statistics on vocational spending and enrollments. Nevertheless, the city-by-city data for 1957 and for 1962 were exploited with conceptually identical econometric models, making the estimates of the several coefficients comparable in all respects.

The Determinants of Current Educational Spending per Student -- An examination of the coefficients of the spending equation derived from the city cross-section for 1957 and given in Table 6-1 reveals little that is qualitatively different from the results obtained for cities in 1962 (Table 4-1). There is virtually no change, for example, in the influence of the endogenous variable, student enrollment rates (Y_2). An increase in the enrollment rate in the 1957 estimates, as in 1962, is associated with a drop in per pupil spending, and the quantitative "magnitude" of this association is, respectively, -.71 and -.74. Thus, as concerns this crucial endogenously determined relationship there was, for all intents and purposes, no change between 1957 and 1962.

Quantitatively, however, there are significant differences between the impacts of other variables helping to determine per student educational outlays in 1957 and 1962. In the former period, per capita income (X_1) exhibited a much stronger positive influence on per pupil spending than it did in 1962. In contrast, median years of schooling of adults (X_3) exerted a much greater negative impact. This latter finding is a bit disturbing and relatively difficult to rationalize. It may be that, given the strong collinearity between the two income variables (X_1, X_2) and the educational attainment variable (X_3), the years of schooling variable is picking up some non-linearity in the spending-income relationship, rather than the partial effect of education on per student spending, which would be the simplistic interpretation.

Table 6-1
The Determinants of Spending per Student, 1957 (Y_1)*

	Y_2 = Log of publicly enrolled students per capita	X_1 = Log of money income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of school completed by the population aged over 25	X_4 = Log of percent of population that is nonwhite	X_5 = Log of population per square mile	X_6 = Log of population	X_7 = Log of average monthly salary per full-time teacher, October	X_8 = Log of percent of publicly enrolled students in high school	X_9 = Log of publicly enrolled students per operating school district (size-weighted mean)	X_{10} = Log of market value of locally assessed taxable property per capita	X_{11} = Log of percent of locally assessed taxable property not commercial or industrial	X_{12} = Log of intergovernmental revenues received from the state government per capita	X_{13} = Log of intergovernmental revenues received from the federal government per capita	Constant	S.E. / $\bar{R}^2$
Row 1 2 Equation 2SLS	-.71 (.18)	.92 (.27)	.12 (.09)	-.67 (.36)	-.06 (.03)	-.01 (.01)	-.01 (.03)	.10 (.18)	.34 (.25)	-.022 (.016)	.04 (.08)	-.25 (.14)	.14 (.04)	.019 (.012)	.94 (2.08)	.1335
Row 2 2 Equation OLS	-.58 (.12)	.92 (.27)	.10 (.09)	-.71 (.35)	-.07 (.02)	-.001 (.01)	-.01 (.03)	.15 (.17)	.37 (.24)	-.02 (.02)	.02 (.08)	-.25 (.14)	.13 (.04)	.019 (.012)	.39 (1.97)	.1324 (.638)

* Standard errors of the regression coefficients are given parenthetically.

For 1957, cities with high nonwhite populations (X_4), the results show, spent less per student on education, as was also the case for cities in 1962. However, the tendency to spend less per student in more densely populated cities (X_5) appears to have been weaker in 1957 than in 1962. This may be attributable to less demand for local services during the earlier years and, consequently, less pressure on local budgets in the more densely populated cities -- which, as Lees has shown,[55] are much more likely to demand disproportionately large amounts of non-educational services from the city government.

For the 1957 sample, differences in the mean of teachers' salaries (X_7) had an appreciably lower impact on per student spending than was the case for 1962. The variation in the teachers' salaries variable was approximately equal in the two sample years, so that coefficient differences do not stem from this source. Rather, it appears that real input levels were really more sensitive to input cost differentials in 1957 than in 1962. In cities where teachers' salaries were relatively high, spending per pupil was held relatively lower in 1957 than 1962. Why this should be the case is subject to conjecture, of course. Two explanations, not necessarily mutually exclusive, are: (1) in response to the observed Soviet successes in education, as evidenced by the "sputnik" feat, Americans became substantially less cost-conscious about their public educational system; (2) the increasing unionization and organization of teachers has resulted not only in more rapidly rising salaries, but in greater constraints being placed on the latitude of educational administrators to economize on resources whose relative price has risen. The consequence of either, or both, of these phenomena would be a lower regression coefficient in 1957 than in 1962 for the teachers' salaries variable.

A comparison of the influence of one of the tax base variables, percent of local property assessed valuation that is residential (X_{11}), in 1957 and 1962 reveals that the negative impact was somewhat higher in 1957, with the estimated regression coefficient being more than 1.5 times its standard error. We have already alluded to the reason why we think there is apt to be a negative association between this determinant and per pupil spending. It rests primarily on the obviousness of the incidence of a tax on residential property versus a tax on commercial and industrial properties, whose true "place" of incidence of course depends upon the demand elasticity for the commodity or service. The fact that the negative impact of a high percentage residential valuation diminished between 1957 and 1962 is, as above, probably explanable as a response to the renewed support of education following "sputnik" but before the so-called tax payers revolt of the late '60's and '70's

Table 6-2

The Determinants of Public School Student Enrollment per Capita, 1957 (Y_2)*

	Y_1 = Log of current spending on education by all local governments per publicly enrolled students	X_1 = Log of money income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of school completed by the population aged over 25	X_4 = Log of percent of population that is nonwhite	X_6 = Log of population	X_8 = Log of percent of publicly enrolled students in high school	X_{14} = Log of percent of population that is Catholic	X_{15} = Log of percent of population that is Jewish	X_{16} = Log of children aged 5-19 as percent of population	Constant	S.E. / $\bar{R}^2$
Row 1 2 Equation 2SLS	.57 (.34)	-.29 (.41)	.04 (.10)	.47 (.41)	.004 (.03)	.003 (.03)	.01 (.31)	-.09 (.04)	-.05 (.03)	1.27 (.40)	-3.31 (2.78)	.1561
Row 2 2 Equation OLS	-.17 (.09)	.36 (.22)	.07 (.07)	.04 (.27)	-.02 (.02)	.01 (.02)	.19 (.22)	-.02 (.02)	-.06 (.02)	.76 (.24)	-2.31 (1.97)	.1122 .63

* Standard errors of the regression coefficient are given in parentheses.

had any appreciable impact. Whether this hypothesis is valid is, naturally, conjectural, but if we should find, as more recent data become available, that the coefficient on X_{11} has again risen (in absolute terms) we would have at least tentative support.

The state aid to education proxy (X_{12}) exhibited a regression coefficient which exceeded three times its standard error in 1957, just as it did in 1962. The coefficient was positive and of about the same size in both city cross-sectional samples. For 1957, a ten percent expansion in state aid per capita was accompanied by a 1.4 percent rise in per student spending; the equivalent percentage change in 1962 was one percent. It should not be inferred from these results, however, that state aid was becoming less effective in generating additional educational spending as time went on. Whether or not this is the case depends, since we are dealing in percentages, upon the relative magnitudes of the two variables, which are reported here on a per student basis for spending and on a per capita basis for the state aid variable. Thus, from the information available we can conclude merely that state aid may have been used to augment local educational resources or to provide substitutes for them.

The Determinants of the Public School Enrollment Rate -- Our estimates of the determinants of the enrollment rate for the urban core areas in 1957 are given in Table 6-2. The estimated response of the enrollment rate to changes in per pupil spending (Y_1) is .57. As in 1962, its sign is positive but in absolute value it is slightly greater than the comparable estimate obtained from the 1962 city cross-section. We have already, in our explication of the 1962 results, ventured our explanation of this relationship. There is no reason inherent in that line of argument why the absolute size of the coefficient should have been greater in the 1957 sample. Since the difference in the 1962 and 1957 coefficients is probably statistically insignificant, no useful purpose is served by speculating about it. Suffice it to note that the enrollment rate in public schools was relatively sensitive to school quality, as measured by per student educational outlays, in cities as in states. But unlike the influence found in the latter jurisdiction this responsiveness has persisted in the city cross-section for some time. This is probably, in the first instance, a reflection of the greater mobility of families in an urban area and its suburbs relative to interstate mobility, at any given point in time. But over time both types of mobility have been on the increase, so that at the state level a responsiveness of the enrollment rate to educational quality shows up in the later sample whereas it was not evident in the earlier samples for 1957 and 1952. Again, more recent evidence from which to compute new elasticities of enrollment rates with respect to spending per student would shed light on this.

Beyond the spending variable, the only other variables which have attendant regression coefficients in excess of 1.5 times their standard errors are those that measure the percent of population which is Catholic (X_{14}) and Jewish (X_{15}) and the percent of the population which is of school age (X_{16}). The "direction" and size of the influences of the religious mix variables are again about the same for the 1957 cross-section as for that of 1962. In contrast, the coefficient of the school-aged children variable is considerably lower in 1957, bringing it more in line with the estimates obtained from the state cross-section. This latter phenomenon may be attributable to significant changes in relative family size in our urban areas between 1957 and 1962, or alternatively to decreases over time in the dropout rate. And, of course, the public school-private school enrollment pattern may have changed appreciably during this short period. But the fact that other variables, especially per capita income levels (X_1), the income distribution proxy (X_2), and the racial mix variable (X_4), do not have regression coefficients that exceed their standard errors casts doubt on the last possibility.

Part 7 -- Determinants of Changes in Spending per Student and Enrollment Rate Variables for the State Cross-Section

The model which we postulated in Part 2 has thus far been estimated with state and city cross-sectional data which measure the levels of the dependent and explanatory variables. The particular hypothesis implicit in this model, although static in conception, nevertheless allows prediction and analysis of changes over time. For this type of analysis one must deal with both changes in the independent variables themselves and with changes in the coefficients over time. Our discussion, then, has developed around the response relationship depicted by the impact of changes in various explanatory variables -- endogenous as well as exogenous -- on educational spending per student and on enrollment rates, both over-all and in vocational programs. It has involved also an explanation of the comparative sizes of the several regression coefficients at different time periods. Still, the estimates discussed so far are basically static.

An alternative hypothesis views the spending and enrollment adjustments as a dynamic process, wherein changes in expenditures per student and enrollment rates interact, and are also affected by changes in the exogenous variables. If the static approach were correct, yet the parameters of the model were measured in dynamic terms, then identical coefficient estimates would be derived from both approaches only if the cross-sectional levels relationships of Parts 3-6 exhibited stable regression coefficients over time. In contradistinction, if, say, changes in "tastes" for education or in educational technology were to alter these parameters over time, then coefficient estimates based on the dynamic version of the model would represent a complex weighted average of the changing coefficients. The latter estimates would also be influenced by the "cross-product" terms between changes in the coefficient estimates and changes in the independent variables.

From our point of view it is unfortunate that a number of gaps in the underlying data preclude the estimation of a complete dynamic cross-sectional model, specified in terms of absolute changes in the variables instead of in terms of their levels. For example, the religious mix variables, percent Catholic and percent Jewish, are available, over the span of time encompassed by our cross-sectional samples, only for a single year. Moreover, for changes from 1957 through 1962, a number of variables that stem from census compilations had to be omitted.

Table 7-1a
The Determinants of Changes in Spending per Student, States, 1952-1962*

	Y_2 = Log of changes in publicly enrolled students per capita	Y_5 = Log of changes in the ratio of vocational enrollment to total public school enrollment	X_1 = Log of changes in personal income per capita	X_2 = Log of changes in percent of families with income less than $3,000	X_3 = Log of changes in median years of education of those 25 and older	X_4 = Log of changes in percent nonwhite	X_5 = Log of changes in population density (per square mile)	X_6 = Log of changes in population	X_7 = Log of changes in average annual salary of instructional staff	X_8 = Log of changes in percent publicly enrolled students in high school	X_9 = Log of changes in publicly enrolled students per operating school district	X_{10} = Log of changes in the estimated market value of taxable property per capita	X_{11} = Log of changes in percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of changes in intergovernmental revenue received from the state government for education per capita	X_{13} = Log of changes in intergovernmental revenue received from the federal government for education per capita	Constant	$\frac{S.E.}{\bar{R}^2}$
Row 1 4 Equation 2SLS	-.67 (.44)	-.17 (.17)	-.10 (.22)	-.22 (.16)	-.62 (.35)	-.10 (.06)	-- --	-.11 (.17)	.47 (.25)	.29 (.21)	.01 (.03)	.11 (.07)	-.10 (.17)	-.00003 (-.02)	.056 (.035)	.36 (.19)	.0890
Row 2 4 Equation OLS	-.28 (.24)	.01 (.08)	-.11 (.20)	-.24 (.15)	-.67 (.32)	-.08 (.06)	-- --	.01 (.13)	.60 (.20)	.35 (.17)	.02 (.02)	.10 (.07)	-.14 (.15)	-.002 (.02)	.04 (.03)	.22 (.14)	.0818 (.492)
Row 3 Partitioned 2SLS	-1.19 (.52)	-- --	-.18 (.25)	-.29 (.18)	-.46 (.40)	-.08 (.07)	-- --	-.04 (.15)	.51 (.24)	.05 (.26)	.004 (.03)	.12 (.08)	-.04 (.19)	.01 (.02)	.06 (.04)	.43 (.19)	.0986
Row 4 Partitioned OLS	-.29 (.22)	-- --	-.11 (.20)	-.23 (.15)	-.67 (.31)	-.09 (.06)	-- --	.004 (.12)	.59 (.20)	.35 (.17)	.02 (.02)	.10 (.07)	-.14 (.15)	-.002 (.02)	.04 (.03)	.23 (.13)	.0806 .5064

* Standard errors are given in parentheses.

Table 7-1b

The Determinants of Changes in Spending per Student, States, 1952-1957*

	Y_2 = Log of changes in publicly enrolled students per capita	Y_5 = Log of changes in the ratio of vocational enrollment to total public school enrollment	X_1 = Log of changes in personal income per capita	X_2 = Log of changes in percent of families with income less than $3,000	X_3 = Log of changes in median years of education of those 25 and older	X_4 = Log of changes in percent nonwhite	X_6 = Log of changes in population	X_7 = Log of changes in average annual salary of instructional staff	X_8 = Log of changes in percent publicly enrolled students in high school	X_9 = Log of changes in publicly enrolled students per operating school district	X_{10} = Log of changes in the estimated market value of taxable property per capita	X_{11} = Log of changes in percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of changes in intergovernmental revenue received from the state government for education per capita	X_{13} = Log of changes in intergovernmental revenue received from the federal government for education per capita	Constant	S.E. $\bar{R}^2$
Row 1 4 Equation 2SLS	-.12 (.19)	-.02 (.08)	.02 (.20)	-.10 (.09)	-.33 (.19)	-.07 (.06)	-.07 (.15)	.55 (.14)	.06 (.08)	.01 (.02)	.14 (.09)	-.19 (.18)	.02 (.03)	.001 (.02)	.14 (.08)	.0495
Row 2 4 Equation OLS	-.33 (.14)	-.02 (.05)	-.02 (.18)	-.08 (.08)	-.31 (.19)	-.06 (.05)	-.16 (.12)	.51 (.13)	.06 (.07)	.007 (.02)	.15 (.08)	-.14 (.17)	.02 (.03)	.01 (.02)	.17 (.07)	.0477 .616
Row 3 Partitioned 2SLS	-.04 (.22)	-- --	-.04 (.17)	-.11 (.08)	-.34 (.20)	-.07 (.05)	-.03 (.14)	.58 (.14)	.07 (.08)	.02 (.02)	.13 (.08)	-.20 (.19)	.02 (.03)	-.04 (.02)	.12 (.07)	.0512
Row 4 Partitioned OLS	-.31 (.13)	-- --	-.04 (.16)	-.09 (.07)	-.31 (.18)	-.06 (.05)	-.14 (.11)	.51 (.13)	.07 (.07)	.01 (.02)	.14 (.08)	-.14 (.17)	.02 (.03)	.005 (.02)	.16 (.06)	.0471 .625

* Standard errors are given in parentheses.

Table 7-1c
The Determinants of Changes in Spending per Student, States, 1957-1962*

	Y_2 = Log of changes in publicly enrolled students per capita	Y_5 = Log of changes in the ratio of vocational enrollment to total public school enrollment	X_1 = Log of changes in personal income per capita	X_2 = Log of changes in percent of families with income less than $3,000	X_3 = Log of changes in median years of education of those 25 and older	X_4 = Log of changes in percent nonwhite	X_5 = Log of changes in population density (per square mile)	X_6 = Log of changes in population	X_7 = Log of changes in average annual salary of instructional staff	X_8 = Log of changes in percent publicly enrolled students in high school	X_9 = Log of changes in publicly enrolled students per operating school district	X_{10} = Log of changes in the estimated market value of taxable property per capita	X_{11} = Log of changes in percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of changes in intergovernmental revenue received from the state government for education per capita	X_{13} = Log of changes in intergovernmental revenue received from the federal government for education per capita	Constant	S.E. $\bar{R}^2$
Row 1 4 Equation 2SLS	-.32 (.95)	-.08 (.17)	.16 (.16)	-- --	-- --	-- --	-- --	.39 (.69)	.25 (.20)	.09 (.10)	-.02 (.06)	.20 (.14)	-.41 (.28)	.01 (.02)	-.06 (.10)	.16 (.07)	.0660
Row 2 4 Equation OLS	-.62 (.34)	-.02 (.09)	.14 (.15)	-- --	-- --	-- --	-- --	.63 (.28)	.26 (.19)	.07 (.08)	-.004 (.04)	.18 (.11)	-.36 (.23)	-.01 (.01)	-.03 (.06)	.17 (.05)	(.0648) .18
Row 3 Partitioned 2SLS	1.56 (4.25)	-- --	.27 (24.62)	-- --	-- --	-- --	-- --	-.91 (2.99)	.12 (28.05)	.08 (4.25)	-.09 (16.33)	.39 (39.96)	-.75 (76.04)	.02 (2.34)	-.20 (32.47)	.07 (18.99)	.0935
Row 4 Partitioned OLS	-.61 (.34)	-- --	.14 (.15)	-- --	-- --	-- --	-- --	.63 (.28)	.26 (.19)	.06 (.08)	-.003 (.04)	.18 (.11)	-.36 (.22)	.01 (.01)	.03 (.06)	.17 (.05)	(.0639) .203

* Standard errors are given in parentheses.

Table 7-2a

The Determinants of Changes in Public School Student Enrollment per Capita, States, 1952-1962*

	Y_1 = Log of changes in current spending on education per publicly enrolled student	Y_4 = Log of changes in the ratio of total vocational spending to total current spending on education	X_1 = Log of changes in personal income per capita	X_2 = Log of changes in percent of families with income less than $3,000	X_3 = Log of changes in median years of education of those 25 and older	X_4 = Log of changes in percent nonwhite	X_6 = Log of changes in population	X_8 = Log of changes in percent publicly enrolled students in high school	X_{14} = Log of changes in percent of population which is Catholic	X_{15} = Log of changes in percent of population which is Jewish	X_{16} = Log of changes in children aged 5-19 as percent of population	Constant	S.E. / $\bar{R}^2$
Row 1 4 Equation 2SLS	-.24 (.12)	-.18 (.05)	.08 (.12)	-.04 (.09)	.04 (.21)	.01 (.03)	-.06 (.06)	-.06 (.12)	-- --	-- --	.19 (.07)	.38 (.08)	.0510
Row 2 4 Equation OLS	-.23 (.10)	-.12 (.04)	.05 (.11)	-.08 (.08)	.07 (.19)	-.001 (.03)	-.07 (.06)	-.10 (.11)	-- --	-- --	.18 (.07)	.39 (.08)	.0491 .482
Row 3 Partitioned 2SLS	-.19 (.14)	-- --	-.003 (.13)	-.17 (.09)	.15 (.22)	-.03 (.04)	-.08 (.07)	-.19 (.12)	-- --	-- --	.17 (.08)	.39 (.09)	.0558
Row 4 Partitioned OLS	-.08 (.09)	-- --	-.003 (.13)	-.14 (.09)	.22 (.21)	-.02 (.03)	-.07 (.06)	-.23 (.11)	-- --	-- --	.20 (.07)	.35 (.08)	.0548 .354

* Standard errors are given in parentheses.

Table 7-2b

The Determinants of Changes in Public School Student Enrollment per Capita, States, 1952-1957*

	Y_1 = Log of changes in current spending on education per publicly enrolled student	Y_4 = Log of changes in the ratio of total vocational spending to total current spending on education	X_1 = Log of changes in personal income per capita	X_2 = Log of changes in percent of families with income less than $3,000	X_3 = Log of changes in median years of education of those 25 and older	X_4 = Log of changes in percent nonwhite	X_6 = Log of changes in population	X_8 = Log of changes in percent publicly enrolled students in high school	X_{14} = Log of changes in percent of population which is Catholic	X_{15} = Log of changes in percent of population which is Jewish	X_{16} = Log of changes in children aged 5-19 as percent of population	Constant	S.E. / $\bar{R}^2$
Row 1 4 Equation 2SLS	-.52 (.13)	-.15 (.05)	.06 (.14)	.06 (.07)	.06 (.17)	-.02 (.03)	-.53 (.08)	.05 (.05)	-- --	-- --	.23 (.06)	.21 (.06)	.0432
Row 2 4 Equation OLS	-.55 (.11)	-.12 (.04)	.07 (.14)	.04 (.07)	.05 (.17)	-.02 (.03)	-.53 (.08)	.05 (.05)	-- --	-- --	.24 (.06)	.22 (.05)	.0429 .732
Row 3 Partitioned 2SLS	-.57 (.17)	-- --	.15 (.15)	-.04 (.07)	.03 (.19)	-.03 (.04)	-.50 (.09)	.08 (.06)	-- --	-- --	.26 (.06)	.20 (.07)	.0475
Row 4 Partitioned OLS	-.51 (.12)	-- --	.15 (.15)	-.03 (.07)	.05 (.18)	-.03 (.03)	-.49 (.09)	.06 (.05)	-- --	-- --	.26 (.06)	.18 (.06)	.0473 .674

* Standard errors are given in parentheses.

Table 7-2c

The Determinants of Changes in Public School Student Enrollment per Capita, States, 1957-1962*

	Y_1 = Log of changes in current spending on education per publicly enrolled student	Y_4 = Log of changes in the ratio of total vocational spending to total current spending on education	X_1 = Log of changes in personal income per capita	X_2 = Log of changes in percent of families with income less than $3,000	X_3 = Log of changes in median years of education of those 25 and older	X_4 = Log of changes in percent nonwhite	X_6 = Log of changes in population	X_8 = Log of changes in percent publicly enrolled students in high school	X_{14} = Log of changes in percent of population which is Catholic	X_{15} = Log of changes in percent of population which is Jewish	X_{16} = Log of changes in children aged 5-19 as percent of population	Constant	S.E. $\bar{R}^2$
Row 1 4 Equation 2SLS	-.22 (.12)	-.03 (.05)	.06 (.08)	-- --	-- --	-- --	.73 (.07)	-.001 (.05)	-- --	-- --	-- --	.11 (.02)	.0323
Row 2 4 Equation OLS	-.26 (.08)	-.07 (.04)	.07 (.07)	-- --	-- --	-- --	.73 (.07)	.01 (.04)	-- --	-- --	-- --	.12 (.02)	.0319 .736
Row 3 Partitioned 2SLS	-.35 (.15)	-- --	.07 (.08)	-- --	-- --	-- --	.73 (.07)	.01 (.05)	-- --	-- --	-- --	.14 (.03)	.0348
Row 4 Partitioned OLS	-.19 (.07)	-- --	.05 (.07)	-- --	-- --	-- --	.73 (.07)	-.01 (.04)	-- --	-- --	-- --	.11 (.02)	.0327 .722

* Standard errors are given in parentheses.

Table 7-3a
The Determinants of Changes in Percent Spending on Vocational Education, States, 1952-1962*

	Y_2 = Log of changes in publicly enrolled students per capita	Y_5 = Log of changes in the ratio of vocational enrollment to total public school enrollment	X_{27} = Log of federal spending on vocational education as a percent of federal spending on education	X_{28} = Log of state spending on vocational education as a percent of state spending on education	Constant	S.E. / $\bar{R}^2$
Row 1 4 Equation 2SLS	-.20 (.58)	.65 (.20)	.12 (.06)	.04 (.03)	-.11 (.09)	.1964
Row 2 4 Equation OLS	-.21 (.46)	.59 (.15)	.12 (.06)	.04 (.03)	-.11 (.08)	.1961 .350
Row 3 Partitioned 2SLS	-.15 (.49)	.66 (.23)	.12 (.06)	.04 (.03)	-.11 (.08)	.1965
Row 4 Partitioned OLS		SAME AS ROW 2				

* Standard errors are given in parentheses.

Table 7-3b
The Determinants of Changes in Percent Spending on Vocational Education, States, 1952-1957*

	Y_2 = Log of changes in publicly enrolled students per capita	Y_5 = Log of changes in the ratio of vocational enrollment to total public school enrollment	X_{27} = Log of federal spending on vocational education as a percent of federal spending on education	X_{28} = Log of state spending on vocational education as a percent of state spending on education	Constant	S.E. / $\bar{R}^2$
Row 1 4 Equation 2SLS	.08 (.33)	.63 (.16)	.13 (.05)	.04 (.03)	-.08 (.03)	.1661
Row 2 4 Equation OLS	.18 (.28)	.37 (.12)	.13 (.05)	.05 (.03)	-.09 (.03)	.1572 .275
Row 3 Partitioned 2SLS	.18 (.30)	.63 (.17)	.14 (.05)	.04 (.03)	-.08 (.03)	.1657
Row 4 Partitioned OLS		SAME AS ROW 2				

* Standard errors are given in parentheses.

Table 7-3c
The Determinants of Changes in Percent Spending on Vocational Education, States, 1957-1962*

	Y_2 = Log of changes in publicly enrolled students per capita	Y_5 = Log of changes in the ratio of vocational enrollment to total public school enrollment	X_{27} = Log of federal spending on vocational education as a percent of federal spending on education	X_{28} = Log of state spending on vocational education as a percent of state spending on education	Constant	$\frac{S.E.}{R^2}$
Row 1 4 Equation 2SLS	.0002 (.47)	.23 (.35)	.10 (.09)	.05 (.03)	-.077 (.067)	.1509
Row 2 4 Equation OLS	-.14 (.38)	.14 (.19)	.11 (.09)	.05 (.03)	-.06 (.06)	.1504 .043
Row 3 Partitioned 2SLS	.24 (.39)	-.08 (.43)	.10 (.09)	.05 (.03)	-.07 (.06)	.1509
Row 4 Partitioned OLS	SAME AS ROW 2					

* Standard errors are given in parentheses.

Table 7-4a
The Determinants of Changes in Vocational Enrollments as a Percent of All Publicly Enrolled Students, States, 1952-1962*

	Row 1 4 Equation 2SLS	Row 2 4 Equation OLS	Row 3 Partitioned 2SLS	Row 4 Partitioned OLS
Y_1 = Log of changes in current spending on education per publicly enrolled student	-.59 (.61)	.52 (.38)	.26 (.60)	
Y_4 = Log of changes in the ratio of total vocational spending to total current spending on education	.41 (.32)	.52 (.15)	.32 (.37)	
X_1 = Log of changes in personal income per capita	.10 (.50)	-.003 (.42)	.10 (.47)	
X_2 = Log of changes in percent of families with income less than $3,000	-.47 (.44)	-.10 (.36)	-.17 (.39)	SAME AS ROW 2
X_3 = Log of changes in median years of education of those 25 and older	.17 (.95)	.86 (.76)	.58 (.93)	
X_4 = Log of changes in percent nonwhite	-.23 (.14)	-.18 (.11)	-.16 (.12)	
X_6 = Log of changes in population	-.60 (.36)	-.52 (.30)	-.58 (.33)	
X_8 = Log of changes in percent publicly enrolled students in high school	.61 (.69)	-.09 (.52)	.18 (.70)	
X_{14} = Log of changes in percent of population which is Catholic	-- --	-- --	-- --	
X_{15} = Log of changes in percent of population which is Jewish	-- --	-- --	-- --	
X_{16} = Log of changes in children aged 5-19 as percent of population	-.61 (.33)	-.31 (.27)	-.37 (.30)	
X_{17} = Log of changes in percent of all workers classified as white collar	-.70 (1.22)	.17 (.98)	.20 (1.01)	
X_{18} = Log of changes in percent of all workers classified as skilled	-.79 (.98)	-.82 (.81)	-1.02 (.90)	
X_{19} = Log of changes in percent of all workers classified as unskilled	-.32 (.45)	-.40 (.38)	-.41 (.39)	
X_{20} = Log of changes in percent of all workers classified as service workers	.67 (.58)	.42 (.45)	.53 (.58)	
X_{21} = Log of changes in current expenditures on higher education per capita	.06 (.45)	.11 (.33)	-.06 (.44)	
X_{22} = Log of changes in retail trade employees as a percent of total nonagricultural employment	.11 (.11)	.07 (.08)	.11 (.11)	
X_{23} = Log of changes in wholesale trade employees as a percent of total nonagricultural employment	.03 (.55)	.08 (.44)	-.06 (.51)	
X_{24} = Log of changes in selected service employees as a percent of total nonagricultural employment	-.74 (.53)	-.47 (.44)	-.49 (.46)	
X_{25} = Log of changes in manufactures employees as a percent of total nonagricultural employment	-.06 (.08)	-.01 (.06)	-.02 (.07)	
X_{26} = Log of changes in the insured unemployment rate.	-.03 (.11)	-.07 (.09)	-.09 (.10)	
Constant	-.26 (.51)	-.57 (.42)	-.46 (.47)	
S.E. / R^2	.1861	.1607 / .378	.1657	

* Standard errors are given in parentheses.

Table 7-4b
The Determinants of Changes in Vocational Enrollments as a Percent of All Publicly Enrolled Students, States, 1952-1957*

	Y_1 = Log of changes in current spending on education per publicly enrolled student	Y_2 = Log of changes in publicly enrolled students per capita	X_1 = Log of changes in personal income per capita	X_2 = Log of changes in percent of families with income less than $3,000	X_3 = Log of changes in median years of education of those 25 and older	X_4 = Log of changes in percent nonwhite	X_6 = Log of changes in population	X_8 = Log of changes in percent publicly enrolled students in high school	X_{14} = Log of changes in percent of population which is Catholic	X_{15} = Log of changes in percent of population which is Jewish	X_{16} = Log of changes in children aged 5-19 as percent of population	X_{17} = Log of changes in percent of all workers classified as white collar	X_{18} = Log of changes in percent of all workers classified as skilled	X_{19} = Log of changes in percent of all workers classified as unskilled	X_{20} = Log of changes in percent of all workers classified as service workers	X_{21} = Log of changes in current expenditures on higher education per capita	X_{22} = Log of changes in retail trade employees as a percent of total nonagricultural employment	X_{23} = Log of changes in wholesale trade employees as a percent of total nonagricultural employment	X_{24} = Log of changes in selected service employees as a percent of total nonagricultural employment	X_{25} = Log of changes in manufactures employees as a percent of total nonagricultural employment	X_{26} = Log of changes in the insured unemployment rate	Constant	S.E. / $\bar{R}^2$
Row 1 4 Equation 2SLS	.30 (1.12)	.19 (.43)	-1.71 (.97)	.17 (.44)	.53 (.92)	-.23 (.18)	-.89 (.53)	-.24 (.39)	-- --	-- --	-.18 (.32)	-1.04 (1.16)	.77 (1.09)	-.97 (.50)	.51 (.60)	-.44 (.64)	.05 (.09)	-.70 (.87)	-.64 (.81)	.03 (.11)	-.13 (.15)	.75 (.54)	.1804
Row 2 4 Equation OLS	.43 (.58)	.03 (.24)	-1.86 (.89)	.23 (.38)	.58 (.80)	-.22 (.15)	-.95 (.51)	-.32 (.25)	-- --	-- --	-.21 (.29)	-.69 (.99)	.72 (.97)	-1.00 (.49)	.62 (.53)	-.63 (.48)	.06 (.08)	-.59 (.74)	-.77 (.61)	.05 (.08)	-.14 (.13)	.80 (.48)	.1797 (.164)
Row 3 Partitioned 2SLS	.45 (.59)	.15 (.49)	-1.76 (.95)	.20 (.39)	.60 (.81)	-.22 (.16)	-.90 (.54)	-.28 (.29)	-- --	-- --	-.20 (.29)	-.95 (1.01)	.70 (.98)	-.99 (.49)	.54 (.59)	-.49 (.67)	.05 (.09)	-.63 (.76)	-.72 (.64)	.04 (.10)	-.14 (.13)	.73 (.55)	.1796
Row 4 Partitioned OLS			SAME AS ROW 2																				

* Standard errors are given in parentheses.

Table 7-4c
The Determinants of Changes in Vocational Enrollments as a Percent of All Publicly Enrolled Students, States, 1957-1962*

	Y_1 = Log of changes in current spending on education per publicly enrolled student	Y_4 = Log of changes in the ratio of total vocational spending to total current spending on education	X_1 = Log of changes in personal income per capita	X_2 = Log of changes in percent of families with income less than $3,000	X_3 = Log of changes in median years of education of those 25 and older	X_4 = Log of changes in percent nonwhite	X_6 = Log of changes in population	X_8 = Log of changes in percent publicly enrolled students in high school	X_{14} = Log of changes in percent of population which is Catholic	X_{15} = Log of changes in percent of population which is Jewish	X_{16} = Log of changes in children aged 5-19 as percent of population	X_{17} = Log of changes in percent of all workers classified as white collar	X_{18} = Log of changes in percent of all workers classified as skilled	X_{19} = Log of changes in percent of all workers classified as unskilled	X_{20} = Log of changes in percent of all workers classified as service workers	X_{21} = Log of changes in current expenditures on higher education per capita	X_{22} = Log of changes in retail trade employees as a percent of total nonagricultural employment	X_{23} = Log of changes in wholesale trade employees as a percent of total nonagricultural employment	X_{24} = Log of changes in selected service employees as a percent of total nonagricultural employment	X_{25} = Log of changes in manufactures employees as a percent of total nonagricultural employment	X_{26} = Log of changes in the insured unemployment rate	Constant	S.E. / $\bar{R}^2$
Row 1 4 Equation 2SLS	-.10 (.54)	.11 (.21)	.02 (.33)	--	--	--	-.38 (.28)	.18 (.18)	--	--	--	--	--	--	--	.12 (.34)	.13 (.58)	.94 (.42)	.10 (.30)	-.31 (.26)	.02 (.07)	-.01 (.14)	.1186
Row 2 4 Equation OLS	.09 (.33)	.14 (.14)	-.01 (.32)	--	--	--	-.41 (.27)	.15 (.16)	--	--	--	--	--	--	--	.06 (.31)	.16 (.58)	.89 (.39)	.12 (.28)	-.34 (.27)	.02 (.07)	-.03 (.13)	.1181 .076
Row 3 Partitioned 2SLS	.22 (.44)	.26 (.29)	-.06 (.34)	--	--	--	-.43 (.27)	.10 (.19)	--	--	--	--	--	--	--	.01 (.33)	.19 (.58)	.93 (.40)	.08 (.29)	-.37 (.28)	.03 (.07)	-.01 (.13)	.1191
Row 4 Partitioned OLS			SAME AS ROW 2																				

* Standard errors are given in parentheses.

For completeness, however, and even though the results are far from satisfactory, the estimates for the four equations, from the state cross-sections, for the three discrete time spans -- 1952-1962, 1952-1957, and 1957-1962 -- are recorded in Tables 7-1a through 7-4c.

A perusal of these tables reveals a number of substantial difficulties. For example, the coefficients of the spending variables (Y_1) in the enrollment equations of Tables 7-2a and 7-2b are negative, whereas in the "levels equation" estimates they are positive (See Tables 3-2, 5-2a, and 5-2b). We find also, using levels data for the 1962, 1957, and 1952 state cross-section samples, in estimates of influences on enrollment rates not reported here that, if the religious mix variables are deleted, the coefficients of over-all educational spending per student and of the ratio of spending on vocational programs variables are generally negative. Moreoever, where any of these coefficients are positive, the coefficient is well below its standard error.

We can only conclude, from this evidence, that the sets of dynamic equation estimates are severely compromised by specification errors and that, because of this, they yield little useful information on the operation of the model. Until data on the crucial religious mix variables become available for another time period, it will be necessary to continue to estimate the model in its "levels" format. Estimation of the dynamic, or "change in levels" model provides no usable cross check on our results.

What has just been said about dynamic results for the state cross-section applies with even greater force to estimates for a dynamic city model. The latter estimates involve a set of variables much smaller than that embraced in the "levels" model estimates. In addition to omission of the religious mix variables, the skill mix and industrial mix variables could not be appropriately adapted to the dynamic format. Because of this huge discrepancy between the "levels" estimates from the city cross-sections and the results from the city cross-sections based on absolute changes in the several variables, the latter are meaningless in the context of the previous analysis in Parts 4 and 6. Therefore, we have not presented our estimates of the parameters for the dynamic model from the two city cross-sections.

Part 8 -- Estimates and Interpretation of the "Core Model"

In many of the estimated equations so far discussed, it is apparent, a number of the independent variables have turned out not to be statistically significant. In a number of instances, as we had anticipated in Part 2, there were a priori reasons to expect this result. In addition, an examination of the simple correlation matrices, which were printed out as each of the foregoing equations was estimated, reveals that there is, among some of the independent variables, an appreciable amount of collinearity. This may in part underlie the relatively high standard errors for some of the estimated regression coefficients. Moreover, there is always the possibility, especially when dealing with a large number of variables in an area where little previous work has been reported on, that a number of variables were insignificant for the simple reason that they were extraneous. In any case, it is of interest to evaluate the consequences of eliminating trivial or irrelevant variables from among the set of explanatory variables and, then, re-estimating the model.

Accordingly in our "core model" we have retained in each equation only those variables whose estimated regression coefficients were, as a minimum, equal to 1.5 times their standard errors in the previously reported 2SLS statistical results based upon the full four-equation or two-equation models, or in the comparable OLS estimates. Re-estimates are presented here for the four simultaneous equations model and for the partitioned version of the model. The estimates are based upon state cross-sections for 1962, 1957, and 1952, and upon city cross-sections for 1962 and 1957. All variables were expressed in terms of "levels." We did not re-estimate the model with the data computed as absolute changes over time because of the absence of crucial data if we are to obtain a respectable specification of the "dynamic" model.

<u>The Determinants of Current Educational Spending per Student</u> -- For convenience, in reporting on the results of our core model estimates, we depart from the previous format and here group together the estimates for each particular equation. In Tables 8-1a through 8-1e we have given the various estimates of equation 1 (see p. 2-6), where the dependent variable is current spending on education per pupil.[56] It can be seen from these results, as well as from the estimates of the enrollment equation for states, that the vocational education variables continue to exert little sizeable impact on the over-all spending and enrollment rate variables.

Table 8-1a
1962, States -- Core Model -- Over-all Spending per Student Equation*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	X_1 = Log of personal income per capita	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_5 = Log of population density (per square mile)	X_7 = Log of average annual salary of instructional staff	X_8 = Log of percent publicly enrolled students in high school	X_9 = Log of publicly enrolled students per operating school district	X_{10} = Log of the estimated market value of taxable property per capita	X_{11} = Log of percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of intergovernmental revenue received from the state government for education per capita	X_{13} = Log of intergovernmental revenue received from the federal government for education per capita	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	-.99 (.37)	-.02 (.05)	-.02 (.16)	-.002 (.30)	-.001 (.02)	-.03 (.03)	.84 (.20)	.36 (.27)	-.03 (.02)	.16 (.09)	-.05 (.25)	.007 (.02)	.03 (.07)	-4.81 (1.48)	.85
Row 2 4 Equation OLS	-.45 (.23)	-.02 (.04)	.10 (.14)	-.11 (.27)	-.008 (.02)	-.004 (.03)	.90 (.19)	.35 (.25)	-.05 (.02)	.13 (.08)	-.15 (.22)	-.001 (.02)	.05 (.06)	-4.38 (1.35)	.87 (.08372)
Row 3 Partitioned 2SLS	-1.16 (.39)	-- --	-.04 (.17)	.02 (.31)	-.001 (.02)	-.04 (.03)	.81 (.21)	.35 (.28)	-.03 (.02)	.18 (.09)	-.02 (.25)	.01 (.02)	.03 (.07)	-4.97 (1.51)	.84
Row 4 Partitioned OLS	-.46 (.23)	-- --	.11 (.14)	-.11 (.27)	-.01 (.02)	-.003 (.03)	.90 (.18)	.34 (.25)	-.04 (.02)	.13 (.08)	-.15 (.22	.001 (.02)	.05 (.06)	-4.43 (1.33)	.88 (.08275)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

Table 8-1b

1957, States -- Core Model -- Over-all Spending per Student Equation*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	X_1 = Log of personal income per capita	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_5 = Log of population density (per square mile)	X_7 = Log of average annual salary of instructional staff	X_8 = Log of percent publicly enrolled students in high school	X_9 = Log of publicly enrolled students per operating school district	X_{10} = Log of the estimated market value of taxable property per capita	X_{11} = Log of percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of intergovernmental revenue received from the state government for education per capita	X_{13} = Log of intergovernmental revenue received from the federal government for education per capita	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	-.62 (.27)	-.09 (.05)	.10 (.19)	-.18 (.31)	-.03 (.02)	.001 (.03)	.55 (.21)	.09 (.11)	-.06 (.02)	.15 (.09)	.005 (.23)	.09 (.04)	-.02 (.05)	-1.86 (1.43)	.87
Row 2 4 Equation OLS	-.41 (.20)	-.03 (.04)	.24 (.17)	-.27 (.29)	-.03 (.02)	.0001 (.02)	.61 (.19)	.07 (.10)	-.06 (.02)	.11 (.08)	.02 (.21)	.06 (.04)	-.01 (.05)	-2.36 (1.36)	.88 (.08541)
Row 3 Partitioned 2SLS	-.80 (.38)	-- --	.18 (.20)	-.35 (.29)	-.05 (.02)	.005 (.03)	.48 (.23)	.06 (.11)	-.05 (.02)	.19 (.10)	.09 (.23)	.09 (.05)	-.01 (.05)	-2.18 (1.44)	.87
Row 4 Partitioned OLS	-.41 (.20)	-- --	.30 (.16)	-.34 (.28)	-.04 (.02)	.001 (.02)	.61 (.19)	.06 (.10)	-.06 (.02)	.11 (.08)	.04 (.21)	.05 (.04)	-.009 (.05)	-2.57 (1.34)	.88 (.08526)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

Table 8-1c
1952, States -- Core Model -- Over-all Spending per Student Equation*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	X_1 = Log of personal income per capita	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_5 = Log of population density (per square mile)	X_7 = Log of average annual salary of instructional staff	X_8 = Log of percent publicly enrolled students in high school	X_9 = Log of publicly enrolled students per operating school district	X_{10} = Log of the estimated market value of taxable property per capita	X_{11} = Log of percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of intergovernmental revenue received from the state government for education per capita	X_{13} = Log of intergovernmental revenue received from the federal government for education per capita	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	-.76 (.22)	-.01 (.04)	.07 (.18)	-.44 (.24)	-.04 (.02)	-.01 (.03)	.70 (.13)	.20 (.15)	-.04 (.02)	.14 (.06)	.07 (.13)	.07 (.03)	.05 (.03)	-3.08 (.94)	.91
Row 2 4 Equation OLS	-.75 (.18)	-.01 (.03)	.08 (.17)	-.45 (.23)	-.04 (.02)	-.01 (.03)	.70 (.13)	.20 (.15)	-.04 (.02)	.14 (.06)	.07 (.13)	.07 (.03)	.05 (.03)	-3.11 (.93)	.91 (.08340)
Row 3 Partitioned 2SLS	-.79 (.23)	-- --	.08 (.18)	-.46 (.23)	-.05 (.02)	-.01 (.03)	.70 (.13)	.20 (.15)	-.04 (.02)	.14 (.06)	.07 (.13)	.07 (.03)	.05 (.03)	-3.10 (.94)	.91
Row 4 Partitioned OLS	-.75 (.18)	-- --	.10 (.16)	-.47 (.22)	-.05 (.02)	-.01 (.02)	.70 (.13)	.21 (.15)	-.04 (.02)	.13 (.06)	.07 (.13)	.07 (.03)	.05 (.03)	-3.15 (.92)	.91 (.08239)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

Table 8-1d
1962, Cities -- Core Model -- Over-all Spending per Student Equation*

	Y_2 = Log of publicly enrolled students per capita	X_1 = Log of personal income per capita	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_5 = Log of population density (per square mile)	X_7 = Log of average annual salary of instructional staff	X_8 = Log of percent publicly enrolled students in high school	X_9 = Log of publicly enrolled students per operating school district	X_{10} = Log of the estimated market value of taxable property per capita	X_{11} = Log of percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of intergovernmental revenue received from the state government for education per capita	X_{13} = Log of intergovernmental revenue received from the federal government for education per capita	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 Partitioned 2SLS	-.70 (.18)	.56 (.20)	-.01 (.24)	-.05 (.02)	-.05 (.02)	.49 (.12)	.15 (.18)	-.01 (.01)	-.008 (.08)	-.19 (.11)	.10 (.03)	-.001 (.01)	-1.30 (1.04)	.80
Row 2 Partitioned OLS	-.56 (.11)	.56 (.19)	-.08 (.23)	-.06 (.02)	-.04 (.02)	.51 (.11)	.19 (.18)	-.01 (.01)	.007 (.07)	-.17 (.11)	.09 (.03)	.0002 (.01)	-1.14 (1.01)	.81 (.09486)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

Table 8-1e

1957, Cities -- Core Model -- Over-all Spending per Student Equation*

	Y_2 = Log of publicly enrolled students per capita	X_1 = Log of personal income per capita	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_5 = Log of population density (per square mile)	X_7 = Log of average annual salary of instructional staff	X_8 = Log of percent publicly enrolled students in high school	X_9 = Log of publicly enrolled students per operating school district	X_{10} = Log of the estimated market value of taxable property per capita	X_{11} = Log of percent of locally assessed taxable property which is not commercial or industrial	X_{12} = Log of intergovernmental revenue received from the state government for education per capita	X_{13} = Log of intergovernmental revenue received from the federal government for education per capita	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 Partitioned 2SLS	-.68 (.18)	.76 (.24)	-.60 (.35)	-.06 (.02)	-.01 (.01)	.11 (.18)	.28 (.24)	-.02 (.01)	.01 (.07)	-.30 (.14)	.13 (.03)	.02 (.01)	2.69 (1.73)	.64
Row 2 Partitioned OLS	-.56 (.11)	.79 (.24)	-.65 (.35)	-.06 (.02)	-.005 (.01)	.15 (.17)	.32 (.23)	-.01 (.01)	.0004 (.07)	-.29 (.13)	.12 (.04)	.02 (.01)	1.89 (1.45)	.64 (.1318)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

Thus, from our core estimates we have reinforced our view that the partitioned version of the model again appears to be the appropriate form.

Only two variables have been eliminated from the set of over-all spending equations as compared with the earlier estimates. These are the variables which measure the proportion of the population with incomes below $3,000[57] and population size <u>per se</u>. The results from these re-estimated equations are very similar to those described above. Current spending on education per student remains negatively related to enrollment rates: as the enrollment rate increases there is diminished spending per pupil. Qualitatively, total educational spending is relatively fixed and independent of public school enrollments.

As for the variables which measure income levels and the budget constraint, the relative sizes of the estimated coefficients vary substantially as between samples. The coefficients estimated for income per capita exceed twice their standard errors for the two city cross-sections, but are well below their standard errors for the state cross-sections. The taxable property variable's coefficient exceeds 1.5 times its standard error for the state samples, but not for city samples. The coefficient for the variable which measures percent residential property is greater than 1.5 times its standard error for cities, but not for the state cross-sections. The signs of all of these coefficients are as expected, however, and indicate that greater incomes per capita, higher property values, and comparatively less residential property tend to generate larger amounts of educational spending per student.

The state aid variable exhibits a positive regression coefficient at least equal to twice its standard error for all samples except the 1962 state cross-section. Federal aid to education generally is associated with a coefficient which is either below, or not very far in excess of, its standard error. Our results from including a racial mix variable in the core model indicate low educational spending per student where the proportion of nonwhites is higher. Population density has a negative impact on current per pupil spending on education in cities, but the estimated coefficient exceeds twice its standard error only for the 1962 cross-section.

In general, the average teachers' salary exerts a strong positive impact on spending per student. With the exception of the data for the 1957 city cross-section, the estimated coefficients for teachers' salaries exceed twice their standard errors. From the fact that in any given year the city cross-sections yield estimates for this coefficient which are appreciably lower than those derived from the state-by-state data, we can infer that there is a greater adjustment in the student-teacher ratio to salary differentials within cities than there is within states as a whole.

Finally, these core model estimates of the over-all spending equation indicate that the percent of students enrolled in high schools is positively associated with spending per pupil. This simply reconfirms the frequently cited fact that higher educational costs are entailed in training the typical high school student, whether he is located in an urban area or not. Moreover, the five sets of results reveal the presence of economies of scale, as measured by school district size. These scale economies appear to be appreciably larger at the state level, but we have already alluded to the possibility that school "districts" at the city level may already be substantially larger than the minimum size at which significant cost decreases can be achieved. Consequently, the presence of this scale-economies phenomenon is not as obvious from city cross-sectional data as it is from that of states.

<u>The Determinants of Public School Enrollment per Capita</u> -- Our core model estimates for the determinants of the enrollment rate, on a per capita basis, are recorded in Tables 8-2a through 8-2e. The variables representing income distribution and population size have again been eliminated from the estimated equation. All other explanatory variables had exhibited regression coefficients which equalled or exceeded 1.5 times their standard errors in at least one of the previous estimates of the determinants of the overall enrollment rate.

It can be seen from these five tables that there is generally a moderate positive influence of per pupil spending on the aggregate enrollment rate, with the estimated coefficient varying with the exact specification of the model; and with a relatively much stronger impact of spending indicated by the city cross-section. In our detailed discussion of the results for cities and of the results for states in 1957 and 1952, we attributed these differences to the greater availability of private educational institutions in cities and over time, which may in part be the result of a minimum size requirement for efficient operation of private schools.[58] Nevertheless, we should differentiate here between the influence of per pupil overall educational spending and the ratio of vocational education spending to over-all spending. For all cross-sections the coefficient of the vocational spending ratio is less than one standard error. Because of these relatively large standard errors on the vocational spending ratio, we believe that the partitioned model is more appropriate than the four- or two-equation models.[59]

Table 8-2a

1962, States -- Core Model -- Over-all Enrollment Rate Equation*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	.17 (.14)	-.02 (.03)	-.13 (.11)	.27 (.17)	.01 (.01)	-.52 (.20)	-.05 (.02)	-.05 (.01)	.13 (.10)	-.80 (.67)	.74
Row 2 4 Equation OLS	.12 (.11)	-.02 (.03)	-.12 (.10)	.29 (.16)	.01 (.01)	-.48 (.19)	-.05 (.02)	-.05 (.01)	.12 (.10)	-.81 (.67)	.74 (.06117)
Row 3 Partitioned 2SLS	.30 (.17)	-- --	-.18 (.12)	.22 (.17)	.008 (.01)	-.60 (.22)	-.06 (.02)	-.05 (.01)	.15 (.10)	-.72 (.69)	.73
Row 4 Partitioned OLS	.14 (.11)	-- --	-.13 (.10)	.31 (.15)	.01 (.01)	-.48 (.19)	-.04 (.02)	-.05 (.01)	.11 (.10)	-.80 (.67)	.75 (.06089)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

Table 8-2b

1957, States -- Core Model -- Over-all Enrollment Rate Equation*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	-.02 (.12)	-.04 (.05)	-.14 (.13)	.06 (.18)	.006 (.01)	.06 (.08)	-.04 (.02)	-.05 (.01)	.16 (.11)	-1.49 (.72)	.75
Row 2 4 Equation OLS	-.03 (.11)	-.05 (.04)	-.13 (.12)	.06 (.18)	.006 (.01)	.06 (.08)	-.04 (.02)	-.05 (.01)	.17 (.11)	-1.50 (.72)	.75 (.07062)
Row 3 Partitioned 2SLS	.09 (.15)	-- --	-.19 (.15)	.04 (.18)	.005 (.01)	.05 (.08)	-.04 (.02)	-.04 (.01)	.16 (.12)	-1.41 (.74)	.74
Row 4 Partitioned OLS	-.02 (.11)	-- --	-.12 (.13)	.07 (.18)	.006 (.01)	.06 (.08)	-.04 (.02)	-.05 (.01)	.16 (.11)	-1.48 (.73)	.75 (.07103)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the R^2 and standard error of estimate figures relative to previous tabular presentations.

Table 8-2c
1952, States -- Core Model -- Over-all Enrollment Rate Equation*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	.06 (.10)	-.03 (.05)	-.06 (.13)	.66 (.14)	.02 (.01)	-.24 (.12)	-.04 (.01)	-.03 (.01)	.85 (.20)	-5.07 (1.25)	.86
Row 2 4 Equation OLS	-.04 (.08)	-.02 (.03)	.03 (.12)	.62 (.13)	.02 (.01)	-.18 (.11)	-.03 (.01)	-.03 (.01)	.89 (.19)	-5.45 (1.20)	.87 (.06109)
Row 3 Partitioned 2SLS	.15 (.11)	-- --	-.12 (.15)	.67 (.14)	.02 (.01)	-.29 (.13)	-.04 (.02)	-.03 (.01)	.80 (.21)	-4.65 (1.30	.85
Row 4 Partitioned OLS	-.03 (.08)	-- --	.04 (.12)	.61 (.13)	.02 (.01)	-.18 (.11)	-.03 (.01)	-.03 (.01)	.87 (.19)	-5.36 (1.18)	.87 (.06068)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the R^2 and standard error of estimate figures relative to previous tabular presentations.

Table 8-2d
1962, Cities -- Core Model -- Over-all Enrollment Rate Equation*

	Y_1 = Log of current spending on education per publicly enrolled student	X_1 = Log of personal income per capita	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 Partitioned 2SLS	.48 (.19)	-.09 (.23)	.26 (.24)	.03 (.02)	-.18 (.22)	-.09 (.03)	-.03 (.02)	1.43 (.26)	-3.21 (.96)	.60
Row 2 Partitioned OLS	-.05 (.09)	.33 (.16)	.18 (.20)	-.003 (.02)	-.02 (.18)	-.04 (.02)	-.04 (.02)	1.21 (.21)	-2.99 (.79)	.73 (.09302)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the R^2 and standard error of estimate figures relative to previous tabular presentations.

Table 8-2e

1957, Cities -- Core Model -- Over-all Enrollment Rate Equation*

	Y_1 = Log of current spending on education per publicly enrolled student	X_1 = Log of personal income per capita	X_3 = Log of median years of education of those 25 and older	X_4 = Log of percent nonwhite	X_8 = Log of percent publicly enrolled students in high school	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{16} = Log of children aged 5-19 as percent of population	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 Partitioned 2SLS	.57 (.33)	-.35 (.35)	.49 (.40)	.007 (.03)	-.009 (.30)	-.09 (.04)	-.05 (.03)	1.26 (.38)	-2.74 (2.05)	.30
Row 2 Partitioned OLS	-.16 (.09)	.26 (.17)	.07 (.26)	-.01 (.02)	.20 (.21)	-.03 (.02)	-.06 (.02)	.74 (.22)	-1.35 (1.42)	.63 (.1117)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

It appears that in higher income states and cities, public school enrollment per capita is lower. This negative relationship between per capita income and the enrollment rate does not disagree with our _a priori_ expectation, as the theoretical discussion of Part 2 indicated that this coefficient could conceivably take on either sign. However, we can have little confidence in the point estimates for this coefficient since these estimates are relatively close in size to the corresponding estimates of the standard errors.

On _a priori_ grounds it was noted that the adult educational attainment variable might appropriately have either a negative or positive impact on the public school enrollment rate. Our core model results show a relatively small but positive impact of adult education levels on the over-all enrollment rate. For two of the state cross-sections the coefficient estimate exceeds 1.5 times its standard error, although this is the case in neither of the estimates from city samples. On the other hand, the influence of the racial mix variable on the enrollment rate is probably so indistinct that it warrants no attention.

For those cross-sections in which the coefficient of the variable showing the high school-grade school mix is greater than its associated standard error the relationship between this particular mix variable and the enrollment rate is negative, as we had anticipated from the age-incidence of the drop-out phenomenon. However, for only two samples (states in 1962 and 1952) is the core model coefficient in excess of 1.5 times its standard error. In consequence, we should probably not place much faith in the core model's ability to demonstrate a relationship between the percent of public school enrollments in high school, on the one hand, and the public school enrollment rate on the other.

The core model performs more respectably, however, when we examine the impact of the religious mix variables. For all cross-sections the variables which measure the percent of the population which is Catholic and the percent which is Jewish have regression coefficients with the expected negative signs. All but the percent Jewish variable for the city samples exhibit coefficients which are at least twice their corresponding standard errors, and the remaining two coefficients exceed 1.5 times their standard errors. Thus, from the core model, as from estimates discussed in preceding sections, it is apparent that availability and "tastes" for private religious schools exert an important influence on public school enrollments.

Finally, the derivation of a coefficient for the age mix variable -- percent of population of school age -- which is less than unity for the state cross-sections, but larger than one for the city samples, is worthy of brief speculation. The indication of a greater tendency to send children to public schools in cities (probably as opposed to private schools) may be a response to relative family size and to the lack of attractive alternatives to school for young people of school age. In states, by way of contrast, when family size is large (relative to income, of course) children may be removed from school at a relatively early age because of attractive job opportunities -- perhaps to work in the agriculture sector.

<u>The Determinants of the Spending Ratio on Vocational Education</u> -- The core model estimates of the equation relating the determinants of the ratio of vocational education outlays to total current spending on education appear, in the three cross-sections, to be close to one another for the full four-equation model. These estimates are given for the state-by-state sample in Tables 8-3a, 8-3b, and 8-3c. (It will be recalled that the absence of published data on vocational educational spending broken down by cities has prevented us from estimating the determinants of vocational spending, and for that matter, vocational enrollment rates, for the city cross-sections.) In our estimates of the core model for states it has been unnecessary to delete any of the original <u>a priori</u> variables from the estimating equation. That is, in our previous results the coefficients of all four variables helping to determine the vocational education spending ratio exceeded their standard errors by a factor of at least 1.5.

For all three core model estimates, the over-all enrollment rate exerts almost a proportional influence on the vocational spending ratio. The impact is slightly more than proportional for the 1957 and 1962 cross-sections, and less than proportional for that of 1952. In all cases, the estimated coefficient is more than twice the value of the corresponding standard error. As we noted in Part 3, this result does not imply that vocational spending per student rises roughly in proportion to total enrollment; for, as we have seen in our discussion of Tables 8-1a through 8-1e, higher over-all enrollments are associated with reductions in per pupil spending.

Turning to the effect of vocational enrollments on vocational spending we notice that the estimated coefficients of the vocational enrollment ratio are positive and range from .3 to .5. In every instance the coefficient estimates exceed twice their standard errors. The positive relationship, of course, reflects our expectations, since we would anticipate relative increases in vocational

Table 8-3a
1962, States -- Core Model --
Vocational Spending Ratio Equation*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	X_{27} = Log of federal spending on vocational education as a percent of federal spending on education	X_{28} = Log of state spending on vocational education as a percent of state spending on education	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	1.28 (.43)	.46 (.14)	.33 (.10)	.11 (.04)	-1.53 (.53)	.66
Row 2 4 Equation OLS	1.03 (.36)	.50 (.11)	.32 (.09)	.10 (.04)	-1.77 (.50)	.67 (.2590)
Row 3 Partitioned 2SLS	1.17 (.43)	.42 (.16)	.33 (.10)	.11 (.04)	-1.77 (.50)	.66
Row 4 Partitioned OLS	1.03 (.36)	.50 (.11)	.32 (.09)	.10 (.04)	-1.77 (.50)	.67 (.2590)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

Table 8-3b
1957, States -- Core Model --
Vocational Spending Ratio Equation*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	X_{27} = Log of federal spending on vocational education as a percent of federal spending on education	X_{28} = Log of state spending on vocational education as a percent of state spending on education	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	1.25 (.28)	.37 (.10)	.14 (.07)	.16 (.04)	-1.16 (.44)	.69
Row 2 4 Equation OLS	1.02 (.25)	.42 (.08)	.14 (.07)	.16 (.04)	-1.43 (.42)	.70 (.2240)
Row 3 Partitioned 2SLS	1.09 (.28)	.37 (.12)	.14 (.07)	.16 (.04)	-1.43 (.42)	.69
Row 4 Partitioned OLS	1.02 (.25)	.42 (.08)	.14 (.07)	.16 (.04)	-1.43 (.42)	.70 (.2240)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

Table 8-3c
1952, States -- Core Model --
Vocational Spending Ratio Equation*

	Y_2 = Log of publicly enrolled students per capita	Y_5 = Log of vocational enrollment divided by total public school enrollment	X_{27} = Log of federal spending on vocational education as a percent of federal spending on education	X_{28} = Log of state spending on vocational education as a percent of state spending on education	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	.93 (.27)	.30 (.11)	.07 (.07)	.11 (.04)	-1.59 (.38)	.52
Row 2 4 Equation OLS	.82 (.24)	.39 (.08)	.08 (.07)	.10 (.04)	-1.58 (.37)	.54 (.2434)
Row 3 Partitioned 2SLS	.90 (.26)	.30 (.13)	.07 (.07)	.11 (.04)	-1.63 (.37)	.53
Row 4 Partitioned OLS	.82 (.24)	.39 (.08)	.08 (.07)	.10 (.04)	-1.58 (.37)	.54 (.2434)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

education outlays as the relative enrollment levels increased in the vocational programs. It should be stressed, however, that the comparatively low elasticity implies that vocational spending per vocational pupil is lower the larger the number of students enrolled in vocational programs. Moreover, since over time our cross-sections indicate an increase in the elasticity of the vocational spending ratio with respect to the vocational enrollment percentage, the phenomenon of decreasing quality, as measured by dollars spent per student, of vocational education may be tapering off somewhat. Again, only estimates based on more recent cross-sections could support or deny the validity of this last hypothesis.

The impact of the federal aid to education variable has obviously, in our core model estimates, become more important over time. For the 1962 sample, the estimated coefficient exceeds three times its standard error, and indicates an important influence of the proportion of federal aid for vocational programs on the proportion of state spending on vocational education. Likewise, the variable which measures the proportion of state aid devoted to vocational education also exhibits a positive coefficient, which exceeds twice the corresponding standard error in each cross-section.[60] However, unlike the case of federal vocational aid, there is here no apparent trend in the coefficients of the state vocational aid variable. Again, this difference is perhaps explained by the disparate spending provisions which frequently are entailed when state or federal aid funds are accepted, as we have mentioned earlier.

<u>The Determinants of Relative Enrollment in Vocational Education Programs</u> -- A number of variables were removed from the original estimating model in order to arrive at the core model specification of the vocational enrollment equation. These included the variables which measure the percent of the population which is nonwhite, the percent of public school students enrolled in high school, and the percent of the population which is of school age. In addition, the three variables measuring the ratios of service sector employees to total non-agricultural employment, of retail trade employees to non-agricultural employment, and of service workers to all workers were deleted before the core model was estimated. Finally, the amount of current per capita expenditures on higher education and the insured unemployment rate were eliminated from the set of explanatory variables. In no case had these variables exhibited coefficients which were greater than 1.5 times their standard errors in the previous estimates.

An examination of Tables 8-4a, 8-4b, and 8-4c, where our results for the core model vocational enrollment

Table 8-4a

1962, States -- Core Model -- Vocational Enrollment Ratio Equation*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_6 = Log of population	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{17} = Log of percent of all workers classified as white collar	X_{18} = Log of percent of all workers classified as skilled	X_{19} = Log of percent of all workers classified as unskilled	X_{23} = Log of wholesale trade employees as a percent of total nonagricultural employment	X_{25} = Log of manufactures employees as a percent of total nonagricultural employment	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	1.15 (.48)	.58 (.15)	-1.29 (.67)	.18 (.35)	1.18 (.76)	.04 (.06)	-.17 (.06)	.08 (.06)	-.81 (.93)	.40 (.71)	-.99 (.53)	.05 (.27)	.25 (.16)	3.80 (7.68)	.68
Row 2 4 Equation OLS	1.36 (.39)	.72 (.12)	-1.37 (.65)	.16 (.35)	1.27 (.74)	.04 (.05)	-.16 (.06)	.08 (.06)	-.84 (.89)	.40 (.70)	-.89 (.51)	.07 (.26)	.24 (.16)	3.23 (7.52)	.70 (.2380)
Row 3 Partitioned 2SLS	1.15 (.43)	.46 (.19)	-1.30 (.69)	.21 (.37)	1.08 (.79)	.03 (.06)	-.19 (.06)	.09 (.06)	-.88 (.95)	.44 (.74)	-1.08 (.55)	.02 (.28	.26 (.17)	4.14 (8.02)	.65
Row 4 Partitioned OLS	1.36 (.39)	.72 (.12)	-1.37 (.65)	.16 (.35)	1.27 (.74)	.04 (.05)	-.16 (.06)	.08 (.06)	-.84 (.89)	.40 (.70)	-.89 (.51)	.07 (.26)	.24 (.16)	3.23 (7.52)	.70 (.2380)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

Table 8-4b
1957, States -- Core Model -- Vocational Enrollment Ratio Equation*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_6 = Log of population	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{17} = Log of percent of all workers classified as white collar	X_{18} = Log of percent of all workers classified as skilled	X_{19} = Log of percent of all workers classified as unskilled	X_{23} = Log of wholesale trade employees as a percent of total nonagricultural employment	X_{25} = Log of manufactures employees as a percent of total nonagricultural employment	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	1.32 (.56)	.71 (.22)	-1.44 (.69)	.18 (.34)	1.91 (.84)	.05 (.06)	-.21 (.07)	.16 (.06)	-1.23 (1.00)	.90 (.91)	-.50 (.61)	.42 (.28)	.02 (.19)	1.52 (6.09)	.63
Row 2 4 Equation OLS	1.14 (.47)	.73 (.16)	-1.32 (.66)	.16 (.33)	1.90 (.84)	.06 (.06)	-.20 (.06)	.16 (.06)	-1.14 (.99)	.80 (.89)	-.47 (.60)	.43 (.27)	.009 (.19)	1.53 (6.07)	.63 (.2722)
Row 3 Partitioned 2SLS	1.06 (.54)	.17 (.30)	-1.30 (.76)	.40 (.40)	1.87 (.97)	.03 (.07)	-.27 (.08)	.17 (.07)	-1.47 (1.16)	1.09 (1.04)	-.86 (.71)	.25 (.32)	.05 (.22)	1.46 (7.05)	.50 (.3162)
Row 4 Partitioned OLS	1.14 (.47)	.73 (.16)	-1.32 (.66)	.16 (.33)	1.90 (.84)	.06 (.06)	-.20 (.06)	.16 (.06)	-1.14 (.99)	.80 (.89)	-.47 (.60)	.43 (.27)	.009 (.19)	1.53 (6.07)	.63 (.2722)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

Table 8-4c

1952, States -- Core Model -- Vocational Enrollment Ratio Equation*

	Y_1 = Log of current spending on education per publicly enrolled student	Y_4 = Log of total vocational spending divided by total current spending on education	X_1 = Log of personal income per capita	X_2 = Log of percent of families with income less than $3,000	X_3 = Log of median years of education of those 25 and older	X_6 = Log of population	X_{14} = Log of percent of population which is Catholic	X_{15} = Log of percent of population which is Jewish	X_{17} = Log of percent of all workers classified as white collar	X_{18} = Log of percent of all workers classified as skilled	X_{19} = Log of percent of all workers classified as unskilled	X_{23} = Log of wholesale trade employees as a percent of total nonagricultural employment	X_{25} = Log of manufactures employees as a percent of total nonagricultural employment	Constant	R-Bar Squared (Standard Error of Estimate)
Row 1 4 Equation 2SLS	1.35 (.57)	.50 (.28)	-.23 (.28)	1.20 (.41)	3.16 (.95)	.13 (.08)	-.18 (.08)	.20 (.08)	-2.52 (1.15)	1.53 (.92)	-1.03 (.44)	-.08 (.31)	.04 (.10)	-10.25 (5.81)	.53
Row 2 4 Equation OLS	1.19 (.43)	.88 (.18)	.08 (.61)	1.06 (.37)	3.09 (.86)	.15 (.07)	-.10 (.07)	.16 (.07)	-2.63 (1.05)	1.49 (.86)	-.89 (.40)	.10 (.28)	.02 (.09)	-10.43 (5.40)	.59 (.2957)
Row 3 Partitioned 2SLS	1.07 (.48)	.50 (.56)	-.07 (.68)	1.10 (.39)	2.96 (.93)	.13 (.08)	-.16 (.11)	.18 (.08)	-2.37 (1.18)	1.44 (.91)	-1.00 (.47)	-.03 (.35)	.03 (.10)	-9.65 (5.83)	.53
Row 4 Partitioned OLS	1.19 (.43)	.88 (.18)	.08 (.61)	1.06 (.37)	3.09 (.86)	.15 (.07)	-.10 (.07)	.16 (.07)	-2.63 (1.05)	1.49 (.86)	-.87 (.40)	.10 (.28)	.02 (.09)	-10.43 (5.40)	.59 (.2957)

* Standard errors of the regression coefficients are given in parentheses. Please note also the inversion of the $\bar{R}^2$ and standard error of estimate figures relative to previous tabular presentations.

equation are reported, makes it apparent that the endogenous variables which measure total educational spending per student and percent spending on vocational education influence the proportion of public school enrollments which are in vocational programs in a positive direction. In general, the coefficient estimates are at least equal to twice their standard errors. The implication of the regression coefficients on these two endogenous variables is that higher spending on vocational education, either due to an expansion in total spending (the fraction spent on vocational education programs remaining constant), or due to an increase in the fraction of educational spending devoted to vocational programs, will result in an increase in enrollments in vocational programs relative to overall enrollments.

Higher per capita incomes, greater levels of educational attainment among adults, and a smaller fraction of the community with income below $3,000 ($2,000 in 1952) are all associated with a smaller fraction of public school students being enrolled in vocational programs. Larger states, in terms of population size, exhibit a higher fraction of vocational education enrollments. Conforming to our previous estimates of the vocational enrollment equation, in the core model vocational enrollments are higher where there are fewer Catholics and where there are more Jews. This latter set of results -- proxies for religious mix -- is perhaps curious, but we have attempted to rationalize it during our previous discussion of Part 3.

Finally, there is the impact of the group of skill mix and industry mix variables to consider. States with a higher percentage of white collar jobs and those with a higher proportion of unskilled jobs find that a smaller percentage of their students is participating in vocational programs. On the other hand, as anticipated, those states with a relatively greater abundance of skilled jobs available have a larger proportion of vocational enrollments. In addition, those areas with an aggregate job content heavily weighted toward the manufacturing sector also have a relatively high proportion of students enrolled in vocational education, and the availability of jobs in wholesaling has a weak but usually positive influcence on the vocational enrollment ratio.

As suggested, and as a comparison with Part 3 would indicate, these estimates from the core model are consistent with those derived from the basic model in which "levels" of the variables, rather than their first differences, are utilized. This consistency between parameter estimates in the two models, the similarity of the results over the three state cross-sections, and the general conformity of the results with our a priori expectations add up to an appreciable "vote of confidence" for our underlying rationale as it applies to state patterns of spending and enrollments over-all and in vocational programs.

Part 9 -- Conclusion

We have examined and interpreted, in the foregoing portions of this report, the results of an econometric model, of four simultaneous equations, whose primary focus was to spotlight the determinants of (1) current educational spending per student, (2) the proportion of educational spending that is made up of outlays on vocational education programs, (3) the enrollment rate in public elementary and secondary schools, and (4) the percentage of publicly enrolled students that is participating in vocational programs. The parameters of the model were estimated from two sets of cross-sectional samples: for states in 1962, 1957, and 1952; and for cities in 1962 and 1957. Because of inadequacies in the data the econometric model, when applied to the city cross-sections, had to be truncated from four to two equations, wherein the simultaneous determination of the two variables relating to vocational education programs was excluded from consideration. Nevertheless, the emphasis in the study was on the interaction between the per pupil spending variables, on the one hand, and the enrollment rates, on the other. Fundamentally, we were trying to establish whether enrollment rates are influenced by changes in spending per student -- which is, at the very least, indicative of the quality of education -- so as to frustrate, in whole or partially, efforts to increase the resources devoted to education, and to do this for both over-all educational programs and for vocational education. Conversely, we wanted to see whether spending per student responds to changes in the enrollment rate, again within a broad programmatic framework.

On the basis of our statistical findings a large number of comparisons is possible, since we have estimated the model for the same geographic unit at different points in time and for different geographic units at the same point in time. Not all of these estimates yield a completely compatible body of information, of course; hence not all of the possible comparisons reveal a consistent set of characteristics for the interrelationships among enrollments and spending, over-all and in vocational programs. However, it is possible to draw forth reasonably firm generalizations from our results. In expressing these, we shall dwell upon the results from the state cross-sectional samples, since only these permitted the exploration of the full ramifications of our econometric model.

We find, for example, that several variables representing both occupational and industry mixes are important determinants of the ratio of all public school students that enroll in vocational education programs, and that these relationships conform to our *a priori* expectations, at least in a "directional" sense. Where the occupations in states, and their industries, are such that a premium would seem to be placed on vocational skills we observe a relatively high rate of enrollments in vocational programs. Moreover, enrollment in vocational programs is negatively related to per capita incomes in a state, indicating that a vocational education is an inferior good in the conventional sense that less of it is demanded as incomes rise. There is, in addition, a salient interaction between the proportion of students enrolled in vocational education and the proportion of educational funds going into vocational programs, although the evidence implies that this interaction was less important the further back in time we selected our sample. Also, vocational program enrollments respond positively to increases in current educational expenditures per student.

Turning to the factors that influence the percentage of over-all educational expenditures that is allocated to vocational programs, we observe that an increase in the ratio of vocationally-oriented students to total students is associated with a smaller increase in the proportion of vocational education outlays. In contrast, those school districts with relatively high enrollments per capita typically tend to allocate a higher fraction of their educational budgets to vocational programs. Finally, state and federal efforts to assist public elementary and secondary education seem to result in a relative expansion of vocational education expenditures.

Perhaps the most important findings relate to the influence of various factors on over-all educational spending and enrollment rates, however. These variables, as already suggested, were the principal focus of our model and the results shed light on the major policy problem to which we referred in our introductory paragraph to this section. The major findings of our study are that, while total current spending on education is positively related to the over-all enrollment rate, the increase in educational spending is less than proportionate. Consequently, a higher enrollment rate is most typically associated with a reduction in educational expenditures per pupil. This relationship, moreover, seems not to be affected by the ratio of students enrolled in vocational programs. Conversely, larger educational outlays per student are associated with an expanded over-all enrollment rate, although the "magnitude" of this latter influence is not substantial. Thus, there is an interaction, or feedback process, between over-all spending per student and enrollments that apparently undermines efforts to improve the quality of education, insofar as per pupil spending is indicative of educational quality. Moreover, and again of policy connotation, the religious mix of the population, i.e., the percent of Catholics and of Jews, has an appreciable inverse influence on public school enrollment rates, suggesting that atrophy of the parochial school system will result in inordinate demands being placed upon public school resources.

It is also reasonably clear from our findings for states that educational administrators have not been content, over the years, to rest on their laurels. We note, for example, that there are apparently economies of scale to be realized as the size (measured by number of students) of school districts grows, although for reasons suggested in preceding portions of this report scale economies are not so evident in the city cross-section. We also observe a tendency, although it is certainly not a powerful one, for increases in teachers' salaries to be absorbed in ways that result in somewhat lower increases in educational outlays per student. Again, this tendency is noticeably weaker for the city cross-sectional sample. Further distinctions between the results for the state and city cross-sections stem from the response of over-all educational outlays per student to the racial mix to income levels, and to our proxy for competing demands upon public funds. For cities, but not for states, we find an appreciable negative relationship between the percent of the population that is nonwhite and population density, on the one hand, and per pupil educational expenditures on the other; whereas a positive relationship between per capita incomes and over-all per student outlays is noted for cities, but not for states.

We could go on at greater length adumbrating the general findings of our study and qualifying them by comparisons over time or, as above, between the state cross-section and the city cross-section samples. The above examples capture the essence of our results, however. We have here not attempted to produce a theoretical underpinning for the findings, nor have we given them the necessary hedges and qualifications that we have included in the body of our report. These, in particular, should be carefully reconsidered, as they offer ample testimony to the shortcomings of the present research. They also pinpoint avenues by which further research on the interface between enrollments and educational spending, in specific program areas as well as in general, can yield even handsomer returns.

Footnotes

1. See J. S. Coleman, "Introduction" to J. E. Coons, et al., Private Wealth and Public Education (1970).

2. J. M. Buchanan, "Taxpayer Constraints on Financing Education," in National Educational Finance Project, Vol. 2, Economic Factors Affecting the Financing of Education (1970), gives additional, more general reasons for the tax payers' revolt against educational funding.

3. K. E. Boulding, "Factors Affecting the Future Demand for Education," in National Educational Finance Project, Vol. 2, Economic Factors Affecting the Financing of Education (1970), especially, pp. 10-13, provides a persuasive general argument about the nature of the budgetary constraint.

4. For a relatively simple discussion of the "philosophy underlying two-stage least squares estimation," see R. J. Wonnacott and T. H. Wonnacott, Econometrics (New York: John Wiley & Sons, Inc., 1970).

5. See A. L. Gustman and G. B. Pidot, Jr., "Interactions Between Educational Spending and Student Enrollment," Economics Department, Dartmouth College, Xeroxed (October, 1971).

6. G. S. Becker, Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education (1964), and by the same author, Human Capital and the Personal Distribution of Income: An Analytical Approach, W. S. Woytinsky Lecture No. 1, University of Michigan, Institute of Public Administration and Department of Economics (1967).

7. Examples, by no means exhaustive, are W. Z. Hirsch, "Income Elasticity of Public Education," International Economic Review (September, 1961); J. Miner, Social and Economic Factors in Spending for Public Education, No. 11 in Syracuse University, The Economics and Politics of Public Education (1963); J. Conlisk, "Determinants of School Enrollment and School Performance," Journal of Human Resources (Spring, 1969); W. W. McMahon, "An Economic Analysis of the Major Determinants of Expenditures on Public Education," Review of Economics and Statistics (August, 1970).

8. Gustman and Pidot, op. cit., have used a simultaneous equations model to explore a more restrictive enrollment-spending interaction. The econometric model used in the present study builds upon and extends the Gustman-Pidot model.

9. The development of our equation explaining current spending per student is roughly consistent with the general spending model used by McMahon, op. cit., who has separated the determinants of educational expenditures into those factors affecting the demand for public education, the costs of providing this education, and the behavior of tax payers. O. Davis, "Empirical Evidence of Political Influence upon Expenditures in Public Schools" in J. Margolis (ed.), Public Economy of Urban Communities (1965), in the framework of a slightly different model, emphasizes the political influences on educational spending. Beyond these two studies, Miner, op. cit., provides a survey of research efforts that has been helpful in our selection of independent variables for the general educational spending equations, as well as the one for vocational spending per student.

10. See J. N. Morgan et al., Income and Welfare in the United States (1962).

11. Ibid., p. 304.

12. Where there are regional differences in per pupil spending that are not reflected in other variables, percent nonwhite may act, in the state cross-section, as a proxy for location in the South. This interpretation of the racial mix variable does not seem to apply to the city cross-section, however.

13. Gustman and Pidot, op. cit., find, for urban areas, a simple correlation coefficient of -0.60 between percent of population in public school and percent greater than 65 years old.

14. H. T. James et al., Wealth, Expenditures and Decision Making for Education (1963), gives a lengthy analysis of the potential influences of private education at the elementary and secondary levels.

15. See, for example, H. Brazer, City Expenditures in the United States, National Bureau of Economic Research Occasional Paper No. 66 (1959); G. Pidot, Jr., "The Public Finances of Local Governments in the Metropolitan United States," doctoral dissertation, Harvard University (1965); and S. K. Lees, for the Institute of Municipal Treasurers and Accountants, Local Expenditure and Exchequer Grants: A Research Study (1956).

Since these variables may serve as proxies for other conditions affecting spending, such as input prices other than teachers' salaries with which they are positively correlated, it is impossible to judge a priori the direction of the net effect on spending of these variables. To help reduce this latter influence, however, we include specifically a measure of teachers' salaries in our spending equations.

16. The application of the concept of scale economies to education is discussed by W. Hettich, "Equalization Grants, Minimum Standards, and Unit Cost Differences in Education," Yale Economic Essays (Fall, 1968); N. W. Hanson, "Economies of Scale as a Cost Factor in Financing Public Schools," National Tax Journal (March, 1964); J. Riew, "Economies of Scale in High School Operation," Review of Economics and Statistics (August, 1966). These studies suggest that school size rather than district size may better "pick up" scale effects in an econometric model. However, since data on average school size were not available, we were forced to employ district size as measure by mean enrollments.

17. H. J. Kiesling, "Measuring a Local Government Service," Review of Economics and Statistics (August, 1967), finds that educational environment and student background, among other non-quantifiable factors, may be a more important influence on students' performance on standardized tests than is educational spending per student.

18. The correction is relatively crude, but we believe it does reduce the gross distortion in assessed values attributable to widely differing assessment rates. In our correction we have adjusted the assessed values for different types of property separately, using the Census of Governments sample data on sales-assessment ratios and also its figures on the composition of the property tax base.

19. A good treatment of these issues is found in G. A. Bishop, "Stimulative vs. Substitutive Effects of State School Aid," National Tax Journal (June, 1964).

20. We are aware of telling arguments against incorporating per capita aid variables in an equation wherein per capita spending on the aided function is the "explained" variable. Our approach -- use of total state and total federal aid per capita in a per student spending equation -- compensates in part for this criticism. It also means we cannot directly estimate the "aid elasticity" of educational spending. For these criticisms see J. S. Osman, "Dual Impact of Federal Aid on State and Local Government Expenditures," National Tax Journal (December, 1966).

21. See F. Welch, "Measurement of the Quality of Schooling," American Economic Review (May, 1966) and J. Morgan and I. Sirageldin, "A Note on the Quality Dimension in Education," Journal of Political Economy (September/October, 1968).

22. Some of the issues in the debate are discussed in S. Bowles and H. M. Levin, "The Determinants of Scholastic Achievement -- An Appraisal of Some Evidence," Journal of Human Resources (Winter, 1968) and J. S. Coleman, "Equality of Educational Opportunity: Reply to Bowles and Levin," Journal of Human Resources (Spring, 1969).

23. See J. N. Morgan et al., op. cit., particularly Chapter 24.

24. In the United States ninety-six percent of all students enrolled in nonpublic elementary schools and eighty-nine percent of all students enrolled in nonpublic secondary schools are found in church-related institutions. U.S. Department of Health, Education, and Welfare, Office of Education, Digest of Education Statistics (1969 edition), p. 29.

25. This is supported statistically by J. Conlisk, "Determinants of School Enrollment and School Performance," Journal of Human Resources (Spring, 1969). See also S. H. Masters, "The Effect of Family Income on Children's Education: Some Findings of Inequality of Opportunity," Journal of Human Resources (Spring, 1969).

26. This is not evident in Table 3-1 where, to avoid clutter, we have listed regression coefficients and their standard errors to only two decimal places. In the actual computations, however, the parameters are carried to a minimum of four decimal places.

27. We have arbitrarily chosen a t-ratio, i.e., a value for the regression coefficient divided by its standard error, of 1.5 as our cut-off for the significance of a variable. Thus, in this report a variable whose regression coefficient is equal to or greater than 1.5 times its standard error is presumed to differ significantly from zero. On a "normal" probability basis, this presumption would be incorrect in roughly 13 percent of the cases.

28. In an analysis with this number of independent variables intercorrelation among them may prove to be a substantial statistical problem. Inspection of our simple correlation matrix reveals, for example, at least one potential problem area in estimating the parameters of equation (1). Median years of educational attainment (X_3) and percent of families with income below \$3,000 (X_2) have

a simple correlation of -.90, suggesting that the estimate might improve if only one of the variables is entered in the estimated equation. However, re-estimation of equation (1) after the elimination of the income distribution variable (X_2) produced virtually no differences in the several remaining regression coefficients.

29. The budget for teachers' salaries varies, of course, from district to district. It constitutes between 60 and 75 percent of total educational outlays in most school districts.

30. The t-ratio is 1.33.

31. See A. S. Goldberger, Econometric Theory (New York: John Wiley & Sons, 1964), p. 360.

32. The remaining coefficients were similar to those obtained above. The figures for the computation are, comparing Rows 1 and 5: $(1.12 - .74)/(1.12 - .63) = .78$.

33. The simple correlation between current educational spending per publicly enrolled student and the fraction of spending on vocational education programs is -.7. In expressing these two variables as we have, we had hoped to reduce the size of this relationship.

34. For example, Morgan et al., op. cit.

35. The standard deviation of this variable -- percent of population aged 5-19 -- is 4.58 percent for our list of states in 1962, against a mean value of 27.7 percent. Thus, the ratio of the standard deviation to the mean is .166, the lowest of any of our thirty-three variables.

36. It should be recalled that the formats of the vocational spending and enrollment equations are different from those of the total spending and total enrollment equation. For the vocational equations, the endogenous variables are defined as a fraction of the associated total variables; for the total equations the variables are defined on a per student or a per capita basis. Thus, the estimated coefficients of the endogenous variables are not directly comparable between equations (1) and (2) and (4) and (5) of Part 2 of this report.

37. Annual Reports, State Boards for Vocational Education (June, 1962), p. 27.

38. These estimates are also given in Gustman and Pidot, op. cit., but the interpretation here is slightly different.

39. Hirsch, op. cit., p. 332.

40. Salaries constitute over sixty percent of current educational expenditures. If there were no substitutability between capital and teachers, and the student-faculty ratio were to remain constant, the elasticity of total spending with respect to salary changes would have to be at least .60.

41. It should be noted that family income serves here as elsewhere to net out the effect of affluence from the impact of years of completed schooling by parents upon the demand for educational services.

42. See Pidot, op. cit., Chaps. 6 and 7.

43. That direct federal aid to education is insignificant in our results is most likely attributable to the very modest levels of funding involved and to the fact that, in 1962, most federal educational aid was still for the so-called "impacted areas" to compensate localities for non-taxability of federal installations, which was concentrated in a few urban centers.

44. There is some empirical evidence that tax considerations probably will have only a minor bearing on workers' decisions about job locations. See, for example, B. Bridges, Jr., "Allowances for State and Local Nonbusiness Taxes," in R. A. Musgrave (ed.), Essays in Fiscal Federalism (1965), especially pp. 214 ff.

45. We have not, it should be noted, demonstrated with a reasonable degree of statistical confidence that the aggregate educational budgets for states with higher enrollment rates are smaller, since the regression coefficient for Y_2 for the state cross-section is less than one standard deviation away from the value of -1.0.

46. See Conlisk, op. cit., and Masters, op. cit.

47. See our derivation of the enrollment equation in Part 2.

48. The correlation coefficient between percent of agricultural output and percent of school aged children across states in 1962 is .38.

49. It is comforting that all specifications of the model yield the same general conclusion for, as we shall see below, in these two earlier years the enrollment rate is not responsive to spending differences. If simultaneity is not important for these early year estimates, the best estimate may be provided by OLS procedures, which is not very different from the 2SLS estimates for these early years.

50. In 1951-1952, 38.5 percent of public elementary and secondary school revenue receipts were from state sources, whereas, as reported in the U.S. Office of Education, Digest of Educational Statistics, 1969, p. 51, for 1961-1962 the comparable figure was 38.7 percent.

51. Note, in the estimates for the 1962 and 1957 cross-sections, that the 1960 census-based estimate for school aged children per capita has been utilized.

52. It should be noted in this context, however, that simultaneous equations bias which stems from the impact of vocational enrollments on the aid variables will lead to overestimates of the coefficients of the aid variables.

53. For the 1957 estimates, the first stage $\bar{R}^2$ is .72 for the equation that predicts Y_4 in the full four equation model. For the partitioned model, the $\bar{R}^2$ is .68. In the case of 1952 data the two $\bar{R}^2$s are .67 and .54 respectively.

54. The $\bar{R}^2$s for the first stage estimates of Y_4 for 1962 are .80 and .70 for the four equation and the partitioned versions of the model respectively.

55. See Lees, op. cit.

56. As before, in the core model estimates, all of the variables were expressed as logarithms. Thus, the dependent variable was actually the log of current spending on education per student. In the text, however, in order to compress and to eliminate clutter, we have omitted reference to the fact that each variable is expressed in logs.

57. The appropriate cut-off figure in 1952 was income below $2,000.

58. See Hettich, op. cit., for an analysis of returns to scale with respect to school size. It should be cautioned, of course, that our quantitative results, insofar as they reveal anything about scale economies, refer to district, not school, size.

59. We have previously pointed out that, to the degree that the estimates from the full four equation and the

partitioned models differ as a consequence of the incorporation of a different set of exogenous variables, there is no "correct" answer concerning which model is better to use.

60. Again we should note the possibility of a simultaneous relationship here which, if present, would impart a positive bias to our estimates of the coefficients of the aid variables.

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Appendix A

Standard Metropolitan Statistical Areas in the 1962 and 1957 City Sample

Birmingham, Ala.
Mobile, Ala.
Phoenix, Ariz.
Fresno, Cal.
Los Angeles-Long Beach, Cal.
Sacramento, Cal.
San Bernadino-Riverside, Cal.
San Diego, Cal.
San Francisco-Oakland, Cal.
San Jose, Cal.
Denver, Col.
Bridgeport, Conn.
Hartford, Conn.
New Haven, Conn.
Wilmington, Del.
Washington, D. C.
Jacksonville, Fla.
Miami, Fla.
Orlando, Fla.
Tampa-St. Petersburg, Fla.
Atlanta, Ga.
Chicago, Ill.
Gary-Hammond, Ind.
Indianapolis, Ind.
Wichita, Kan.
Louisville, Ken.
New Orleans, La.
Baltimore, Md.
Boston, Mass.
Springfield-Holyoke-Chicopee, Mass.
Worcester, Mass.
Detroit, Mich.
Flint, Mich.
Grand Rapids, Mich.
Minneapolis-St. Paul, Minn.
Kansas City, Mo.
St. Louis, Mo.
Omaha, Neb.
Jersey City, N. J.
Newark, N. J.
Patterson-Clifton, N. J.
Albany, N. Y.
Buffalo, N. Y.
New York, N. Y.
Rochester, N. Y.
Syracuse, N. Y.
Utica-Rome, N. Y.
Akron, Ohio
Canton, Ohio
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio
Dayton, Ohio
Toledo, Ohio
Youngstown, Ohio
Okalhoma City, Okla.
Tulsa, Okla.
Portland, Ore.
Allentown, Pa.
Harrisburg, Pa.
Philadelphia, Pa.
Pittsburgh, Pa.
Wilkesbarre, Pa.
Providence, R. I.
Knoxville, Tenn.
Memphis, Tenn.
Nashville, Tenn.
Beaumont-Port Arthur, Tex.
Dallas, Tex.
El Paso, Tex.
Ft. Worth, Tex.
Houston, Tex.
San Antonio, Tex.
Salt Lake City, Utah
Norfolk, Va.
Richmond, Va.
Seattle, Wash.
Tacoma, Wash.

APPENDIX B

Sources of Statistical Data

The sources of empirical data are listed below. Following the citation for each source is found the specific series contained in the given statistical compilation.

National Council of Churches of Christ in the U.S.A., Churches and Church Membership in the U.S., Series A-E, New York: 1956-58:

X_{14} -- Percent of Population Which Is Catholic

X_{15} -- Percent of Population Which is Jewish

U.S. Bureau of Labor Statistics, Employment and Earnings Statistics for States and Areas (various years):

X_{22} -- Retail Trade Employees as a Percent of Total Nonagricultural Employment (in conjunction with County and City Data Book)

X_{23} -- Wholesale Trade Employees as a Percent of Total Nonagricultural Employment (in conjunction with County and City Data Book)

X_{24} -- Selected Services Employees as a Percent of Total Nonagricultural Employment (in conjunction with County and City Data Book)

X_{25} -- Manufactures Employees as a Percent of Total Nonagricultural Employment (in conjunction with County and City Data Book)

U.S. Bureau of the Census, Census of Governments (various years):

X_1 -- Personal Income per Capita

X_5 -- Population Density (per square mile)

X_6 -- Population

X_{10} -- Estimated Market Value of Taxable Property per Capita

X_{11} -- Percent of Locally Assessed Taxable Property Which Is Not Commercial or Industrial

U.S. Bureau of the Census, Census of Population (various years):

X_4 -- Percent of Population that Is Nonwhite

X_{16} -- Children Aged 5-19 as Percent of Population

X_{17} -- Percent of All Workers Classified as White Collar

X_{18} -- Percent of All Workers Classified as Skilled

X_{19} -- Percent of All Workers Classified as Unskilled

X_{20} -- Percent of All Workers Classified as Service Workers

U.S. Bureau of the Census, County and City Data Book (various years):

X_2 -- Percent of Families with Income Less than \$3,000 (\$2,000 in 1952)

X_3 -- Median Years of Education of Persons 25 and Older

U.S. Department of Labor, Manpower Report of the President (various years):

X_{26} -- Insured Unemployment Rate

U.S. Office of Education, Digest of Annual Reports of State Boards for Vocational Education to the Office of Education (various years):

-- Total Vocational Spending (divided by total current spending to derive Y_4)

-- Vocational Enrollment (divided by total public school enrollment to derive Y_5)

X_{27} -- Federal Spending on Vocational Education as a Percent of Federal Spending on Education (in conjunction with Statistics of State School Systems)

X_{28} -- State Spending on Vocational Education as a Percent of State Spending on Education (in conjunction with Statistics of State School Systems)

U.S. Bureau of the Census, Census of Population (various years):

X_4 -- Percent of Population that Is Nonwhite

X_{16} -- Children Aged 5-19 as Percent of Population

X_{17} -- Percent of All Workers Classified as White Collar

X_{18} -- Percent of All Workers Classified as Skilled

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-- Total Vocational Spending (divided by total current spending to derive Y_4)

-- Vocational Enrollment (divided by total public school enrollment to derive Y_5)

X_{27} -- Federal Spending on Vocational Education as a Percent of Federal Spending on Education (in conjunction with Statistics of State School Systems)

X_{28} -- State Spending on Vocational Education as a Percent of State Spending on Education (in conjunction with Statistics of State School Systems)

U.S. Office of Education, <u>Statistics of State School Systems</u> (various years):

- Y_1 -- Current Spending on Education per Publicly Enrolled Student
- Y_2 -- Publicly Enrolled Students
- X_7 -- Average Annual Salary of Instructional Staff
- X_8 -- Percent Publicly Enrolled Students in High School
- X_9 -- Publicly Enrolled Students per Operating School District
- X_{12} -- Intergovernmental Revenue Received from the State Government for Education per Capita
- X_{13} -- Intergovernmental Revenue Received from the Federal Government for Education per Capita
- X_{21} -- Current Expenditures on Higher Education per Capita